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THOMAS GALE.

1507–1587.

VERY little is known of Thomas Gale, one of the great surgical teachers of the sixteenth century. He was born in London in 1507, and was apprenticed to Richard Ferris, afterwards Serjeant Surgeon to Queen Elizabeth. He practised for a time in London, and served with the army at Muttrell in 1544, and at the siege of St. Quentin in 1557. He then settled again as a London surgeon, and became Master of the Company of Barber Surgeons in 1561.

Machyn, in his *Diary*, tells of a great day during his mastership when his side won at an archery meeting at Moorfields. "The xx day of June (1562) there was a great shooting of the Company of Barber Surgeons for a great supper at their own Hall for a xxx mess of meat—and they had six drums playing and a flute and two great ancients (flags) and as a shot was won down went that and up the other and Master Gale and his side won the supper."

But if little is known of his life, his writings are a pure joy to read. Who at the present day would begin a surgical treatise in this way?—

"Phœbus, who chaseth away the dark and uncomfortable night, casting his golden beams on my face, would not suffer me any longer sleep, but said, 'Awake for shame and behold the handywork of our sister Flora, how she hath revested the earth with the most beautiful colours, marvellously set in trees, plants, herbs, and flowers; insomuch that the old and withered coat of winter is quite done away and put out of remembrance; at which words of Phœbus my heart quickened in me and all desire of sleep was eftsoons forgotten. Wherefore I am now come into this beautiful meadow to recreate myself and gather some of those pleasant herbs and flowers which here do grow. But let me see, methink I see two men walking together and reasoning also very ernestly. I will approach nearer unto them, perchance they be of my acquaintance. Surely I should know them. I am deceived if the one be not my friend Master Gale and the other Master Field. It is so indeed, wherefore I will go and salute them. God that hath brought us together into this place, make this day prosperous and fortunate unto you both.

"THO. GALE.—'Brother Yates, the same we wish unto you, and you are welcome into our company.'

"JOHN FIELD.—'This fair and pleasant morning will not suffer Master Yates to keep his bed, but leaving the city he roameth the fields to espy out some strange herbs unto him yet unknown.'

"JOHN YATES.—'I must of force confess that you hit the nail on the head, but since my hap is so fortunate as to meet with you both and that now in this pleasant morning I would leave off my former determined purpose and would require you to enter into some talk of Chirurgery. For since you both were brought up under Master Ferris (being now Serjeant Chirurgion unto the Queenes Majestie), one at whom, both for his knowledge and experience, you did not a little profit, and also that you have had long practice yourselves, you should marvellously pleasure me and profit other, for so may it come to pass, that it might be in the place of an Institution unto those that shall hereafter desire the knowledge of Chirurgery.'"

Surgery is then discussed by question and answer, and Gale shows that a surgeon needs as instruments "incision shears, an incision knife, a fleam, a lancet, a cauterising

iron, a pair of pincers or nippers to take off plaisters, a probe to search the wound with, a crooked hook, a needle, and a quill to sew and stitch with." He may also have a trepan, a speculum oris, a speculum matricis, a syringe masculine and also feminine. "In my judgment," says Gale, "a Trepan is most necessary and of an excellent invention in hurts of the head. For without it where the cranium is fractured, bruised, or else of the inward panicles depressed, you shall little prevail. I myself have used it with great profit divers times and especially once in Cambridgshire anno 1559. A servant of Master Wroth's riding in the fields and leading a young horse in a halter, tied fast about the arm of the servant, the horse being wild and not broken, starting aside, unhorsed the man and drew him by the arm about a great field so long that what with striking, what with drawing, haling and pulling being wearied, he stood still until company came and unloosed the halter and took up the man half dead and removed him unto his master's house. Chirurgions were sent for, who finding the servant speechless and without remembrance of any one whom he saw, they not perceiving the cause thereof themselves, neither yet could be shewed of the patient the place affected, departed and left him uncurable. Master Wroth sent for me, and I, seeing him speechless and without remembrance, conjectured the hinder part of the head to be hurt and smitten of the horse, which I was more certain of when feeling that part I found it soft. Wherefore I, taking off the hair, did first make incision and after that set a Trepan on his head and bored the Cranium through and took out the piece of bone, which done, there issued much blood, black in colour and drawing to putrefaction. out of the contused and broken veins. The next day following the servant spoke and came again to his perfect remembrance, and I, using things in this cure as art required, God restored the man in my hands to his perfect health. I could also show you other examples where the like chances have happened and the Chirurgions either not knowing or wilfully neglecting this profitable instrument have brought the patients to their last end, so happened it to a servant of Maister Paget's in Philpot lane in 1538."

Following the *Institution of a Surgeon*, and like it, issuing from "my house in London" the second of August, 1563, are the four books of *The Enchiridion of Chirurgerie*, addressed by Gale "unto the young men of his Companie, studients in the noble art of Chirurgerie". The book, he says, was written for four special reasons, because previous textbooks "were writ in a tongue which the most of you understand not or the authors use corrupt and barbarous names of sickness and medicines or they be too tedious and long or else too concise and briefe."

The teaching of the *Enchiridion* is sound; thus in cases of gangrene: "If the leg chance to come to such corruption beneath the knee, that of necessity you are constrained to take it off from the other part, it is best to cut it off one good hand's breadth beneath the knee. So shall the party have a resting place for a stilt to go upon. And although it needeth no more but to take his foot off only, yet forasmuch as the rest of his leg should be but a trouble unto him, it is better to take it off under the knee, as I have said before; for the pain will be all one and the danger is least in that place. And further you must take diligent heed that you make your incision above the corrupted parts, for else the flesh or bones being corrupted above the place whereat you make your incision might cause you to have a new work to the great grief and pain of the patient as I have seen oftentimes. And therefore if the corruption have taken the joint of the knee, so that it cannot be cured, but that of force the member must be amputated and cut off, then take it off three fingers breadth above the knee, or in any wise take it not off in the juncture of the knee for that is very dangerous and contrary to the opinions of all the ancient writers. And that order you observe in taking off the leg, the same shall you follow in taking off the arm. But before you begin this work you ought well to consider with yourself and also to call other expert men to you to see the patient, conferring with them whether there be any way to keep on the member and to cure it by any way possible, for it is great slaunder to the art of Chirurgerie and also matter in conscience to take away any member which otherwise might by art be cured, although it be both painful and long or it be done."

Thomas Gale,

THOMAS GALE

Reproduced from the octavo edition of his works published in 1563.

Gale, therefore, had settled in his own mind that a gangrenous limb should be amputated well above the affected part and not through it. But the question remained unsettled for many generations to come in spite of his teaching. The expression " matter in conscience " is unusual, and is perhaps evidence that the writer had not given up the old faith in which he must have been educated.

Gale's real claim to remembrance rests on his *Treatise of Gunshot Wounds* published in 1586, where he starts with " The Proposition or Thema that the usual Gun-powder is not venomous, neither the shot of such hotness as is able to warm the flesh and produce an eschar ". The theory that bullet wounds were poisonous was held by all writers on surgery, but Gale disproved it after a painstaking enquiry, and gives sound advice as to the treatment of gunshot wounds.

" If so be that you cannot without great pain and much searching find the shot, it is much better to let it remain within, than with provoking of mortal accidents labour the taking of it out. For there is no danger in letting the shot remain in and there is great peril in long searching. I myself, serving at Muttrell under the mighty and puissant Prince Henry the eighth about the year of Christ's incarnation 1544, had the experience of eleven sundry soldiers shot into the body, without piercing of any inward member, and I could not get out the shot without great difficulty and making incision, and therefore I, letting the shot remain within the body, did perfectly cure the patients and they lived long after without any grief or pain provoked by the shot.

" In like manner about the year of Christ 1557 whenas Philip King of Spain besieged St. Quintaines, I then serving under him had divers soldiers in cure wounded in like sort as is rehearsed and the shot still remaining in the body, they were (thanked be God) restored to health. I do also now call to remembrance that there came a soldier to London, when I first practised the art of Chirurgery, who was shot in the belly at the siege of Pavia and made perfectly whole, the pellet remaining within. This soldier twelve years after he was thus cured coming to the City had a great Apostume in the flank. I then among others being then called to the cure we applied such medicines to the Apostume, as we accustomably do to Apostumes named Bubones, engendered in that part. And when the apostume brake and came to suppuration we took out a pellet of lead and after did cure the ulcer and make the man whole. These I do bring only for example's sake that other Chirurgions being in the wars should not too much busy themselves or put the patient to pains or in danger in taking out the shot."

In 1566 Gale published a second volume of surgical works, mostly translations with a running commentary. The most important is his treatise *On the Office of a Surgeon*, which is a scathing indictment of the condition of contemporary surgery. It is prefaced with a little copy of verses which begins :—

" Go forth my painefull booke
Thou art no longer mine
Eache man may on thee looke,
The shame or praise is thine.

" Thou mightest with me remaine
And so eschew all blame,
But since thou art so fayne
Go forth in God's name."

After drawing attention to the wiles of unlicensed practitioners of surgery, he says : " I will not speake further of a multitude of strangers, as pouch makers and pedlers, with glass makers and coblers, which run out of their own countries and here become noble physicians and Chirurgions, such as now is most in estimation and ruleth all the roast in our country so that the poor English men and such as have served in the time of wars with expenses of their goods and loss of their lives, yea and the rest of them that be living must of necessity serve at all times both by land and sea, as well in the time of wars as in the

time of pestilence. These poor men, I say, are constrained to serve to their utter undoing, and when they come home again, they, their wives and their children, may go pick mussels, for this jolly company afore spoken of, have taken up all their acquaintance whilst they were serving in the wars."

It is clear, therefore, that war produced the same professional results in the sixteenth as in the twentieth century, and that we have made no material moral progress in the interval.

The portrait of Thomas Gale is prefixed to the octavo edition of his works published in 1563. It represents him as a surgeon wearing the cap and ring of a Master of Surgery and the gown of a Barber Surgeon. The portrait is not identical with that of John Halle which was reproduced in the BRITISH JOURNAL OF SURGERY, vol. V, p. 182, though it closely resembles it in many respects. It is probably therefore a real portrait by the same engraver. It does not appear in either of the volumes of the 1586 edition, which are small quartos published by Thomas East.

CYSTS, AND PRIMARY CANCER IN CYSTS, OF THE BREAST.

By Sir G. LENTHAL CHEATLE, London.

The ideas contained in this paper are based upon observations made from 'whole sections' of female breasts. Should any success be attained by these observations it will depend entirely upon the fact that they were made upon the study of whole sections. Small sections cut from small portions of diseased breasts are of no value except that their perusal can establish a diagnosis of cancer; but generally, small sections can throw little light upon the origin of cysts and primary cancer in cysts of the breast.

I believe the proposals to which I refer are a true conception of the state of affairs. But the failure to convince surgeons on one point does not exclude the possibility of success in securing their conviction on the remaining points.

But I hope I shall not fail to convince the reader that cancer can and does begin in cysts, and further, that not only can it begin therein, but it also gives rise to such definite and typical microscopical appearances that this source of origin can be thereby demonstrated.

This article is divided into two parts: (I) Cysts in the breasts; and (II) Cancer of cysts in the breasts.

I.—There are two types of cyst, *A* and *B*. The difference exists in the character of the epithelium which lines their cavities and intracystic growths. Intracystic, simple, papillomatous growths are common in both types, and their presence is, in the absence of clinical signs, most frequently quite unsuspected. In both types the cysts are multiple. I may say here that I have never seen a breast which contained a single cyst. Both types usually co-exist in the same breast, and both types make their appearance in the breasts that are apparently normal, and others that are obviously abnormal, of women about middle age.

A. This type of cyst is duct in origin, and cystic breasts mainly of this type contain many dilated ducts which give rise to the cystic condition and cystic appearance on section. *Figs.* 95, 96, and 97 are whole sections of cystic breasts belonging mainly to this type. The cysts are lined by duct epithelium, and at the periphery of the breast the cysts branch and terminate in the acini of the glands, and the acini are not necessarily dilated (*Figs.* 95A *and* 96A). In the description of *Fig.* 95, I indicate the presence of an intracystic papillomatous growth. I may say here that its epithelium is very prolific, and that therefore its nature is very suspicious and possibly malignant. The size of the cysts diminishes in calibre as they reach their end. Perhaps *Fig.* 97A shows my point more convincingly. A is a duct which happens to be cut longitudinally at its bifurcation, and with the exception of a single interruption in each of the resulting branches (due to part of the fibrous tissue making its appearance as a result of a slight deviation in the courses of the branches) they terminate in branches of diminishing sizes in acini. The ducts become tortuous and almost varicose, and hence give rise, on microscopical examination, to the false appearance of many cysts, when really they are in direct continuity and form part of one tortuous dilated duct. All ducts are not affected.

The cysts appear to stop (or begin) at the part where the musculature of the nipple reaches its lowest distribution (*Fig.* 103A). This breast, although reproduced to illustrate the type of cancer to which I am about to refer, also shows the cysts beginning with almost

dramatic suddenness below the musculature of the nipple. The ducts in the nipple do not exhibit the marked dilatation seen in continuation below. As a rule, only occasionally and in advanced disease do they show cystic change. Hence there seems to be a possible

FIG. 95.—Part of whole section of cystic breast, showing cysts and their termination in undilated acini at A, and a little higher in same duct, just above duct A and at an angle of 45 degrees to it, is a branch, into the interior of which can be seen projecting a small intracystic, papillomatous growth.

difference in behaviour between those parts of a duct in the nipple and those parts which are situated in the breast below the musculature of the nipple. I do not offer any explanation of this fact; but it suggests, what I do not believe to be altogether true, that some mechanical reason may intervene at this part and cause dilatation of the distal parts of

the duct. I do not believe that cysts of the breast are mainly due to mechanical obstruction. The appearance of the epithelium in these cysts seems to indicate that its proliferation is causing the cyst rather than the reverse. Further, I have examined whole sections of a small breast cut in serial sections, the nipple of which was the site of Paget's disease of the nipple. Although all ducts in their passage through the nipple were

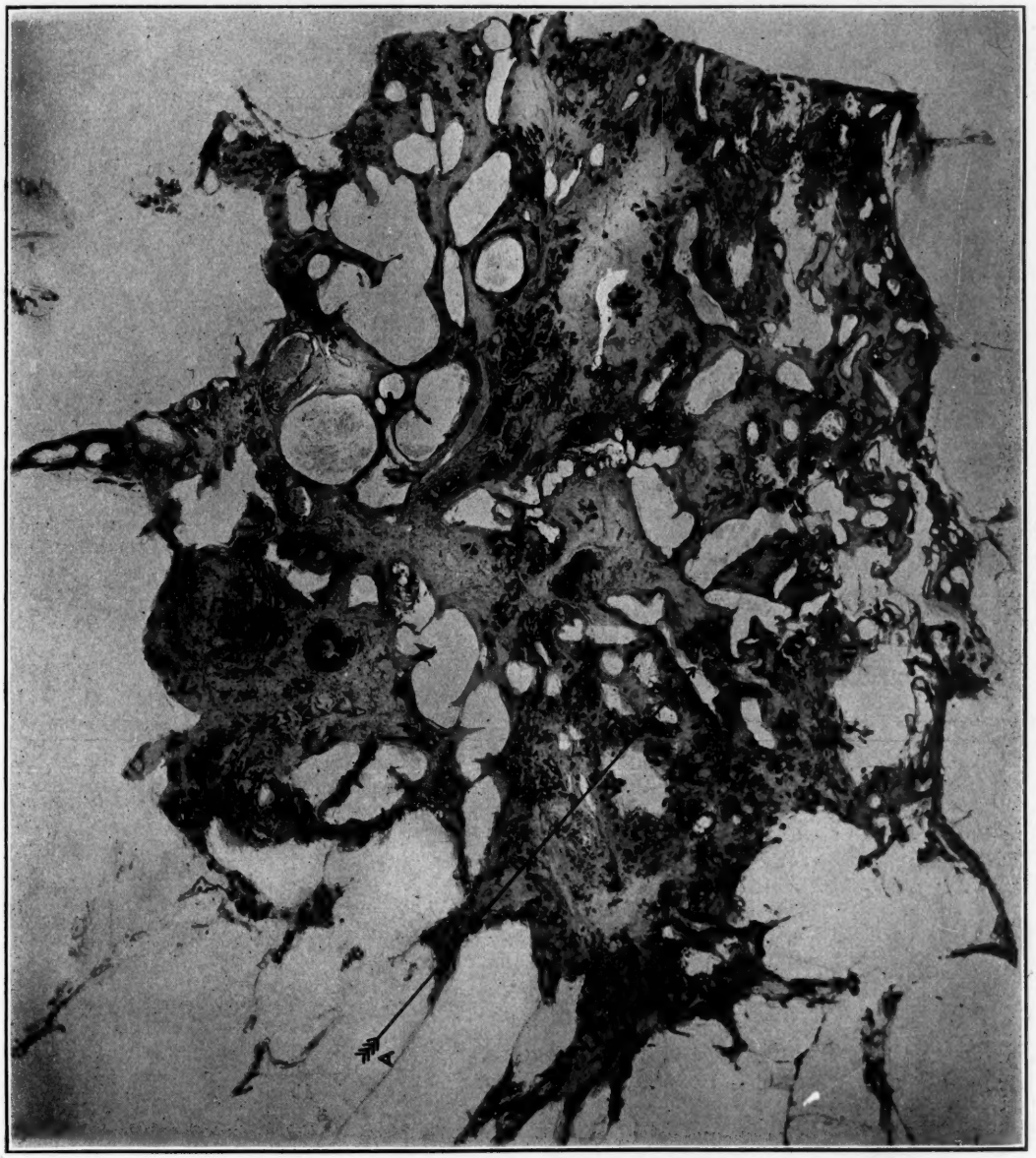

FIG. 96.—Part of whole section of cystic breast, showing cysts and their termination in undilated acini A.

obstructed, there was no dilatation of the ducts below the nipple except those which contained new growth. It is the definite papillomatous formations in cystic ducts that lead me to assume that the proliferation of epithelium is the important factor in cystic formation and that cysts form to accommodate the epithelium. On the other hand, it is quite clear that intracystic growth may intervene quite independently of the cause of cystic development.

B. The cyst seen in *Fig.* 111 is a good representation of this type; its wall and the surfaces of its intracystic papillomatous growths are lined by columnar epithelium, beautiful in appearance, with feathery well-defined cells. My reason for describing it under a different heading from the other cysts is that there is some doubt from which previously existing epithelium-containing structure they arise.

FIG. 97.—Part of whole section of cystic breast, showing cysts and their termination. At **A** a duct is bifurcating and happens to be cut so that the resulting branches are shown to their termination in undilated acini.

Some observers state that they arise in acini, and that before the acini become cystic the cells lining them become feathery, and elongated and columnar. I have very carefully studied this statement, and I have many sections of different breasts which make it impossible to say that it is untrue. On the contrary, in these sections there are changes that can only be interpreted by saying that the epithelium of acini became columnar prior

to the cyst formation therein, and it appears that the epithelial activity had a great deal to do with the cause of cyst development. Further, I have two sections from separate breasts which show a duct lined by its typical columnar epithelium terminating abruptly in a microscopical cyst lined by the feathery epithelium just described, and which appears

FIG. 98.—Part of whole section of same breast as in *Fig.* 99. It shows the cysts becoming filled with epithelial proliferation; the epithelium grouping itself within the cysts in curious formation of lacework, and resembling in parts the spokes of a wheel. In some there is intracystic growth of more definite nature. In no part of this breast was there any indication of epithelial elements in fibrous tissue or fat outside the cysts. Certain cysts can be seen coalescing.

to be an acinus. But, on the other hand, I am just as convinced that in the epithelium-lined ducts (and there can be no doubt they are ducts) can be seen the same type of feathery cells, and I have sections which prove it.

The presence in the cyst of this particular columnar feathery cell cannot alone

determine the source of the cyst. Therefore I cannot say in what structure the cyst in *Fig.* 112 arose. Many observers of the greatest repute tell me they are sure it arose from a duct. I am very doubtful if it can be anything else than an acinus.

II. I now desire to show that within cysts, whatever be their origin, cancer can begin. Cysts situated at the extreme periphery of breasts often become the site of cancer; and the only cysts that show very marked epithelial activity in breasts removed for cystic disease only are often situated at the periphery.

For the sake of my argument the tumour shown in *Fig.* 98 is very important. It shows the state of affairs, to which I draw attention, in an early part of the process. *Fig.* 99 is a reproduction under higher power of the same section, and shows simple cysts and others which are gradually being filled with great epithelial proliferation. In no part of this breast can be found any sign of epithelium spreading in the fat or fibrous

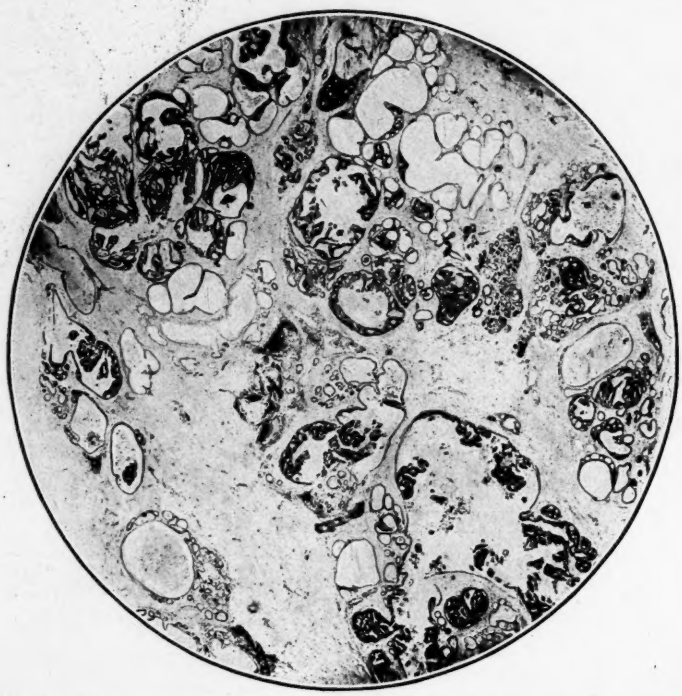

FIG. 99.—A photograph made with a higher power from part of *Fig.* 98, showing the curious lacework formation of epithelium within the cysts. In parts the spaces in the meshwork of epithelium are seen occupied by delicate fibrous tissue, in others by degenerated epithelial cells, and in others by degenerated fibrous tissue. There are a few small collections of lymphocytes here and there, but no epithelial elements can be distinguished outside the cysts in this particular breast.

tissue of the gland. The epithelial activity is limited, so far as I could determine, to the inside of the cysts. There are definite indications that contiguous cysts have become, and are becoming, confluent. Implication of axillary lymphatic glands was absent. I would like to have been able to show that A and A^2 in *Fig.* 98 are parts of the same duct, and that B^1, B^2, B^3, and B^4 are parts of another duct or are branches of the same duct as A and A^2. In serial sections made from the tumour of *Fig.* 103, I can show that exactly the same appearance can be explained in this way, and that the cancer must be diffused about the breast a great deal through this cause.

Fig. 100 is a photograph of another breast, in which the same type of disease is present but in a more advanced condition, and the epithelial cells can be seen invading extensively the fibrous tissue of the gland in its central parts, and the adipose tissue in its peripheral parts.

FIG. 100.—From a whole section of breast in which the same grouping of epithelium within the cysts occurs. But in addition the fat and fibrous tissue are invaded by epithelial elements. In the lower part of the section, where fat is being infiltrated, the epithelium can be seen inclining to the same curious grouping as observed within the cysts. The disease has advanced further in this breast than in that of *Fig.* 98.]

Figs. 101 and 102 are parts of the same breast more highly magnified. It will be seen that the contents of the cysts in *Fig.* 100 are identical in appearance with those in *Figs.* 98 and 99. Within the cysts in each tumour (*Figs.* 98 and 100), the epithelial cells are grouped together in curious typical forms. They resemble lacework. I venture to call it 'laciform'. Equally typical, and a variation of the laciform appearance, the epithelial cells are so grouped as to resemble the spokes of a wheel—a regular cart-wheel appearance is seen in *Fig.* 104A. These finer papillomatous changes are seen as well as the coarser. The coarser papillomatous change is well observed in the cyst A, *Fig.* 98.

FIG. 101.—From same section as *Fig.* 100 under higher magnification.

Nobody could doubt the malignancy of the disease in the breast of *Fig.* 100, and very few would doubt it in *Fig.* 98 : I regard it as malignant. Furthermore, those extracystic parts into which the epithelial cells have spread, and which are, comparatively speaking, spacious or capable of being rendered spacious, will be seen to show an inclination of the epithelial elements to group themselves into the same laciform appearances as those seen within the cysts.

It may be definitely stated that these laciform and cart-wheel appearances are typical of this form of cancer, and from what I have seen it can be observed only in this type, and is therefore diagnostic.

I have seen cancers of this type in which the disease appears to have been more abundant where it was spreading outside the cysts, compared with the growth

FIG. 102.—The same as *Fig.* 101.

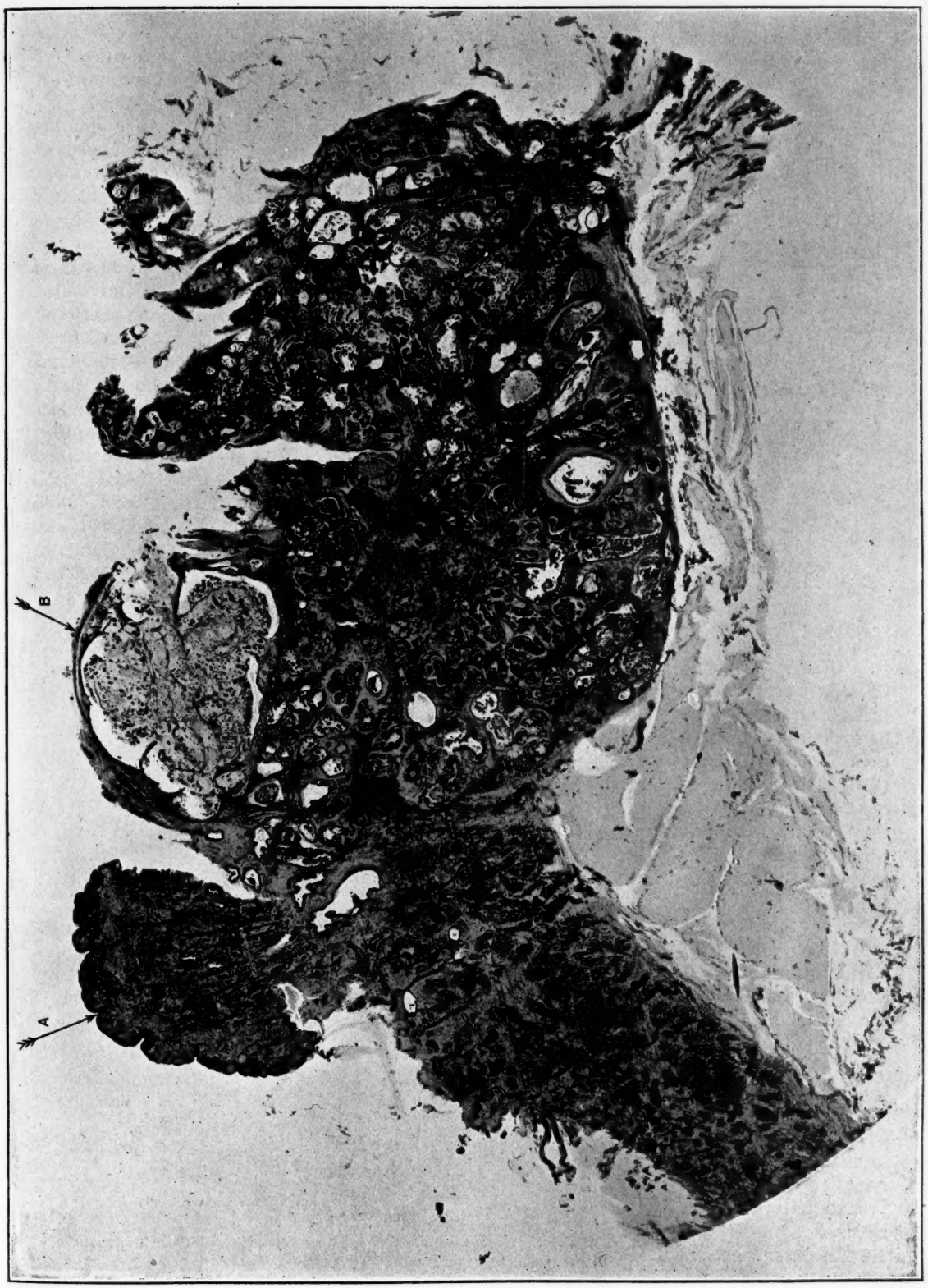

FIG. 103.—Whole section of breast in which the disease has advanced further than that of *Fig.* 100. Epithelial grouping within the cysts is the same, but neighbouring cysts have in some parts become confluent. Fibrous tissue has been invaded. At **B** colloid degeneration of parts of the tumour has occurred. The cancer is situated mainly in the cystic part of the breast on the right of the section. **A** points to the nipple, the ducts of which are embedded in dense musculature immediately below which dilatation of some ducts has occurred. No ducts within the nipple were dilated.

FIG. 104.—A higher magnification of a part of *Fig.* 103, showing the cart-wheel appearance described in text, A.

within their walls, a fact which need surprise no one familiar with the enormous degree to which cancer of the breast may spread throughout the body.

Fig. 103 is a photograph of another breast in which the cancer is most obvious in the right half of the section. The cancer is of the same type as in the previous sections, but it is in a still more advanced degree. Barriers between neighbouring cysts have disappeared and rendered the cysts confluent, parts of the tumour have undergone colloid degeneration at B, and, although confined mainly to the breast itself, the epithelial cells have invaded its fibrous tissue and the lymphatic glands in the axilla. Yet in *Fig.* 104 (which is a more magnified part of *Fig.* 103) can still be seen the same characteristic appearances. I have serial sections of this breast, and in them I can trace the course of an enormous cancer-bearing duct from the nipple to the extremity of the periphery of the breast. The following is the course taken by it of some of its branches.

It begins at the nipple and first runs parallel with the skin. It then bifurcates.

The upper branch continues parallel to the skin, and towards the periphery bifurcates; the upper branch ends in a malignant cyst, the lower branch passes out of the series.

The lower branch passes

FIG. 105.—Shows an edge of a breast tumour, the type with which this article deals. A indicates its spread in fat.

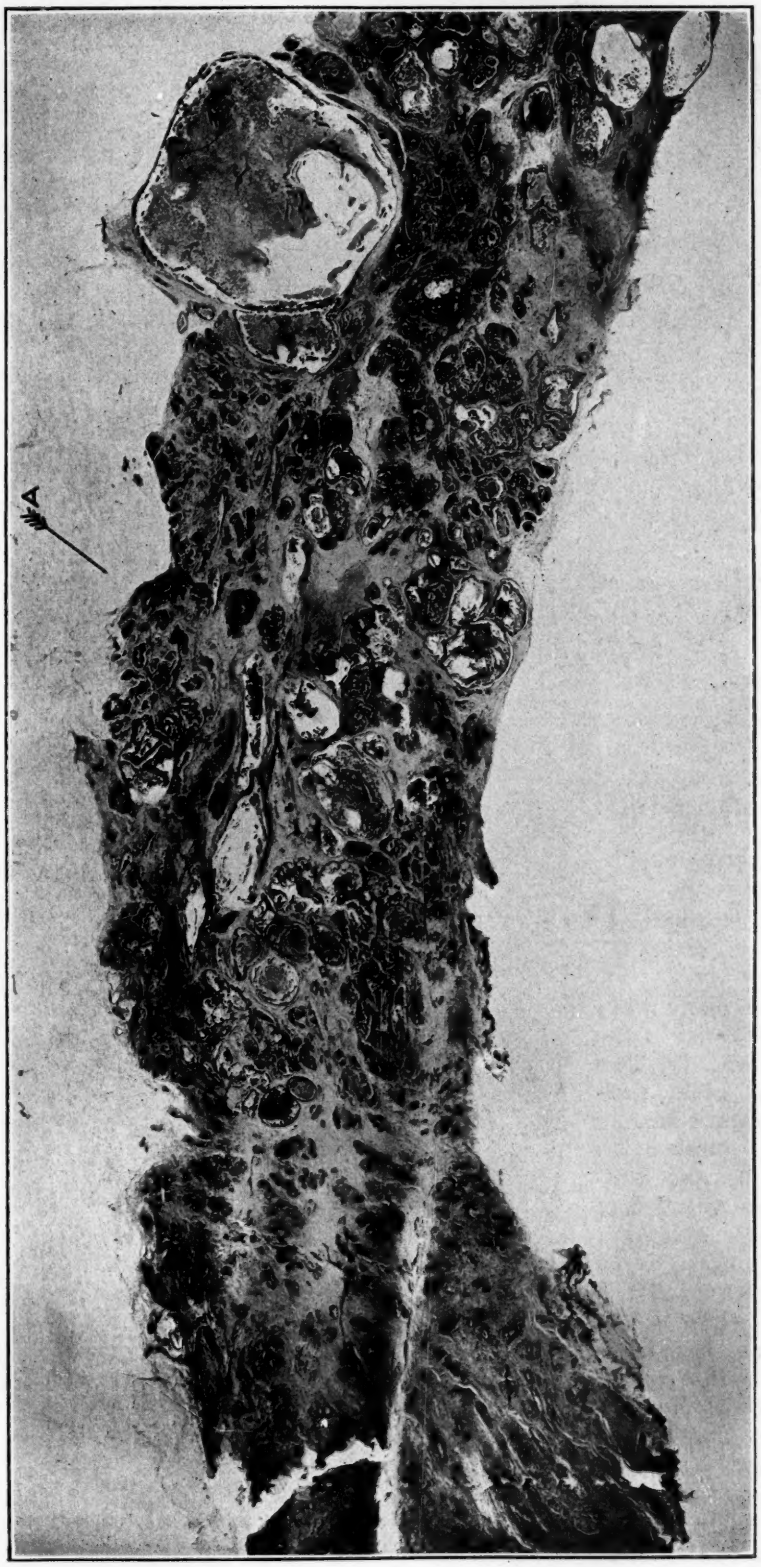

FIG. 106.—Part of whole section of breast in which the disease was very malignant. Cysts are seen containing the lacework and cart-wheel grouping of epithelial cells. Epithelial cells are invading fibrous tissue of the breast.

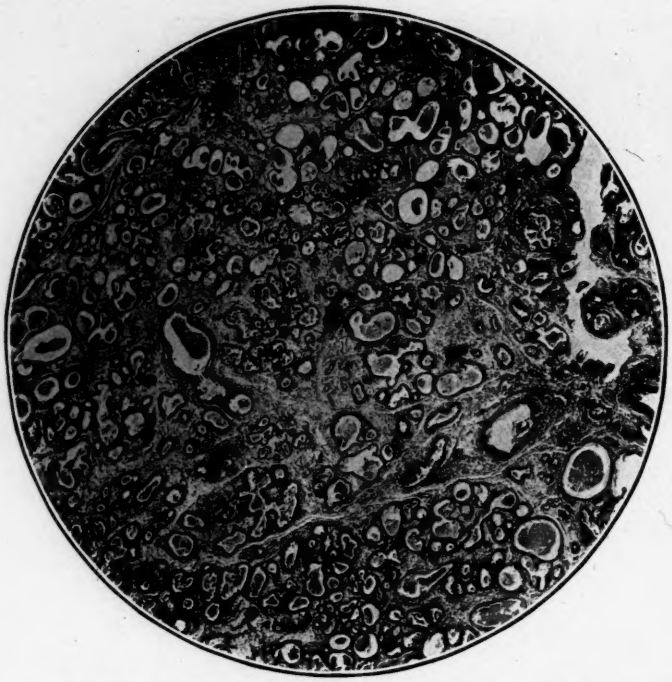

FIG. 107.—Part of section of breast tumour composed entirely of this structure. All the spaces appear to be ducts. Here and there there is a very small amount of epithelial invasion of fibrous tissue.

at an angle of 45° from the main duct, downwards to the pectoralis major, but at the extreme periphery the two branches into which it had bifurcated pass out of the series.

Fig. 106 is a photograph of a breast in which the cancer is behaving in precisely the same way. This patient died of the disease, which appeared to be most malignant and rapid in its course.

Figs. 107, 108, and 109 are photographs of a breast tumour unique in my experience. The whole tumour was unencapsuled, and appeared to be composed of ducts. Some of the ducts examined under higher power (*Fig.* 108) show the same laciform appearance that I have described in the previous tumours. *Fig.* 109 is taken from the edge of the growth. No lymphatic glands were implicated, and the patient from whom it was extensively excised is still well, over ten years after the operation.

There are many ways in which cysts assist in the spread of cancer: (1) Two cancer-bearing cysts coalesce; (2) A cancer-bearing cyst invades a simple cyst; (3) A cancer-bearing periduct lymphatic vessel may invade a simple cyst or a cancer-bearing cyst.

Many of us are inclined to hope and believe all is well when no lymphatic gland in the axilla can be found cancer-bearing. I am very sorry to say that I have found the lymphatic vessels as they pass over the first rib to be cancer-bearing when no cancer could be detected in any lymphatic gland of the axilla.

FIG. 108.—Shows a higher magnification of some of the ducts seen in *Fig.* 107. The lacework formation is typical, and there is epithelial invasion of lymphatic vessels. The cysts are gradually becoming confluent.

It would be very interesting and instructive to decide which of the two types of simple cysts described in I, *A* and *B*, are the chief foci in harbouring the incidence of cancer. I believe they are mainly those described under *A*, for the following reasons. In all malignant tumours of this class there is to be seen at some part (more or less in degree) the thicker and coarser papillomatous tissue associated with duct cancer as we know it (see bottom of *Fig.* 114 and the cyst in *Fig.* 115). Also if cancer-bearing duct-cysts were cut transversely instead of longitudinally as in A, *Fig.* 98, they would show exactly the same appearances as those seen in other cysts of *Figs* 98 and 99, and in the cysts of *Figs.* 100, 101, 102, 103, 104, 105, 107, and 115. I have many sections that prove this point. Also in *Fig.* 114 the coarse papillomatous tissue is seen in one cyst, and higher up on the left of the photograph is seen another containing the laciform structure. Again, the cyst in *Fig.* 115 contains both elements, the coarse papillomatous and the laciform.

FIG 109.—Shows the edge of the tumour depicted in *Figs.* 107 and 108.

Finally, in those tumours where the coarse papillomatous tissue can be seen in the process of permeation, the permeated epithelial cells do not form coarse papillomatous structure, but resemble the laciform fabric, and then only where space is available for its peculiar and particular formation. I regard the last as so important an observation that I hope the editors of this journal will allow me the opportunity of showing in greater detail the microscopical appearances and my interpretation of them in this particular form of very interesting and instructive tumour. It would add to my argument, and I hope would soften and subdue many criticisms that may be made on this article.

But I have whole sections of a malignant cystic breast which appears to me to be made up of the acinus type of cell and most fine papillomatous structure.

The observations of my paper are not intended to be only academic. Take, for instance, the breast from which *Fig.* 113 is a photograph. Blood is to be observed in almost every duct, and it occurred in this way. I removed a large portion of the breast for the purpose of diagnosis. The part of the breast shown in *Fig.* 113 was left behind at that time, and

FIG. 110.—Shows cysts and intracystic growth from a breast removed post mortem. The death of the patient was caused by disease unconnected with mammary tissues.

FIG. 111.—Shows cysts and intracystic growth in another breast removed post mortem. The patient died from disease unconnected with mammary tissues.

was removed a week later on the verification of cancer existing in the parts removed. Upon the examination of the parts shown in *Fig.* 113, to my surprise I found nearly all the ducts full of blood. At the preliminary operation and afterwards there was no hæmorrhage ; everything healed normally. Blood could not have been forced by great pressure into these ducts ; there was no pressure. Therefore it shows the ease with which foreign matter can spread in ducts when once entrance is gained. Hence, how important it must be to guard against the entrance of foreign matter that may be irritating as a traumatic or an infective agent. It must be admitted that, in the case I am describing, entrance of the blood was not gained through normal channels, but through channels unguarded by nipple structures. The ducts in the normal nipple are surrounded by dense musculature which may act as an accidental means of closing ducts by its density, or as an intentional agent by which they are closed by muscular contraction induced by a reflex act that is stimulated by the entrance of irritating or infective foreign matter. The latter action is more than extremely probable.

FIG. 112.—Shows more duct changes in a breast removed post mortem, death being due to cases unconnected with mammary tissues. Cysts with intracystic growths are to be seen. Some collections of lymphocytes are in their neighbourhood, but there is no epithelial invasion of lymphatic vessels. There were other cystic changes in the same breast.

Having seen the ease with which foreign matter becomes distributed when entrance is once gained, it is important to suggest every precaution in one's power to prevent its entrance. Therefore I advise that all nipples should be cleansed with boiled water, and that the use of any means for cleansing or so-called ' hardening ' the nipples which contains irritants should be rigidly and permanently abandoned ; also that the use of soap and anything likely to obstruct ducts should be avoided. It is important to state that soaps may, in some brands especially, contain very irritating substances, the action of which would be far greater when applied to an epithelial surface unaccustomed to irritants, like the duct epithelium, than it would be when applied to surfaces accustomed to, and prepared by nature to, resist them, like the skin epithelium.

The prominent practical issue that arises from this paper is the treatment of cyst-containing breasts. The more one studies this great and important problem, the

greater appear the difficulties, for the following reasons. If one breast be cystic, the other commonly contains cysts. If only one big cyst be obvious clinically, there is in most cases a large cystic element elsewhere in the breast when examined microscopically. I have no evidence that cystic breasts are prone to cancer; my evidence shows only that cancer can originate in cysts, and in some breasts the cysts are so small that they cannot be distinguished upon a clinical examination, and become obvious only on investigation with the aids of the microscope and whole sections. I have no evidence to show that a

FIG. 113.—Half of a whole section of breast from which a part had been removed a week previously for diagnostic purposes. Nearly all the ducts contain blood.

large cyst is more dangerous than one that is microscopical. I can show only that cysts of all sizes may contain simple papillomata and primary cancer.

The problem of treatment is made no easier if breasts be examined, post mortem, of patients who have died from ailments totally unconnected with mammary disease. For a good many years I have examined breasts from the post-mortem room, and *Figs.* 110, 111, and 112 are photographs of abnormalities seen quite commonly in many of these breasts. The cyst (*Fig.* 111) containing intracystic papillomatous growths is quite a

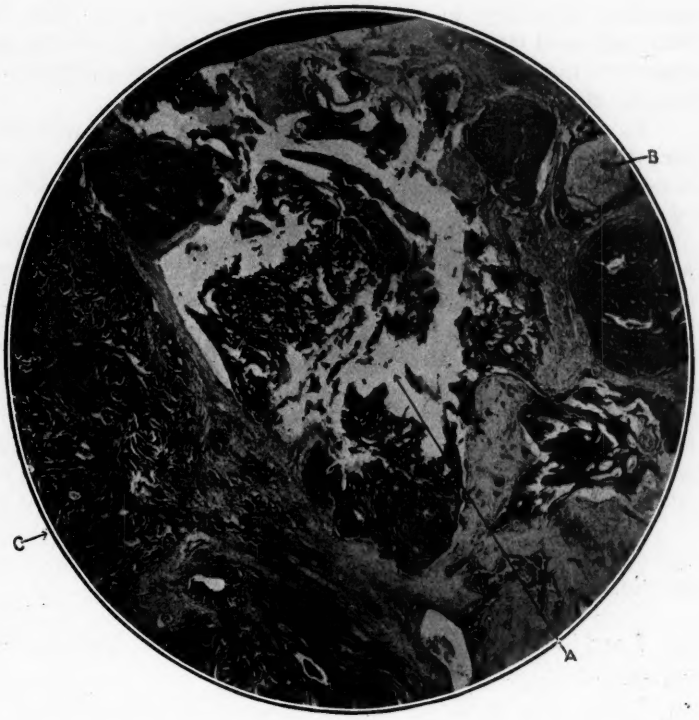

FIG. 114.—Part of a whole section. The disease was very advanced, and the site of the breast contained little or no normal glandular structures. This is a photograph from a part of the tumour's edge. The structure of the tumour, which was large, is seen on the right, and the spread of the disease is seen on the left, where the papillomatous part of the tumour is more pronounced and coarser than in the preceding tumours (A). But at B can be seen part of it which exactly resembles appearances which are so obvious in these tumours. In making a report upon this case it was obviously necessary to examine the tumour and the tissues into which the disease spreads. If a small section had been made only of those parts into which the cancer had spread (C), then it would have been reported as being an ordinary scirrhus of the breast.

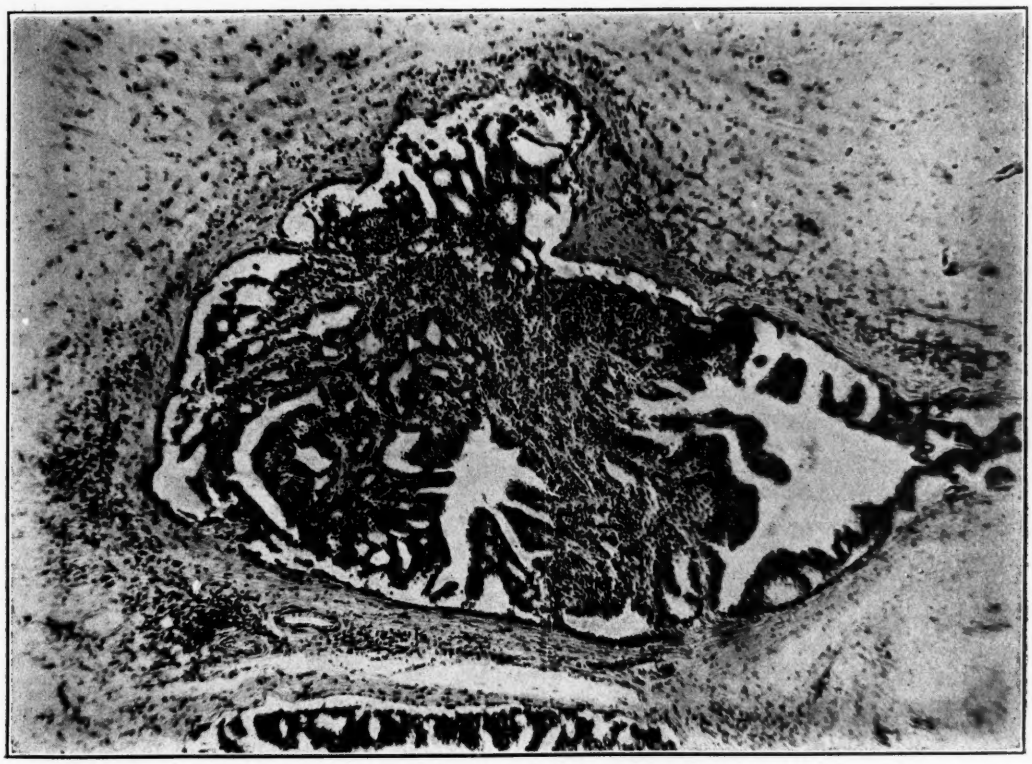

FIG. 115.—Photograph of a malignant cyst which contains the coarse papillomatous structure, as well as the finer laciform fabric.

common discovery in presumably normal breasts. The ducts seen in *Fig.* 112 are of very ugly and threatening aspect. Fortunately so sinister an appearance is not generally observed, but I have whole sections of breasts removed for cystic disease which show very similar changes.

In the face of this evidence it would be unwise and useless to suggest that all cystic breasts should be excised; for, if my remarks be true, it would be necessary to examine microscopically the breasts of all women about middle age, and in a very large proportion cystic changes would be found.

After consideration I am bound to say I would advise the removal of every breast which is obviously clinically cystic. I would advise this course if only a single cyst were clinically present, for the reason I have given. In practice I leave the nipple and axillary lymphatic glands. Some surgeons, I know, are removing cystic breasts as the means of getting rid of cystic breasts, and my evidence compels me to believe that breasts that are known to be cystic ought to be excised with the object of preventing a far greater calamity. I am sure cysts can be dangerous. In most cases totally unsuspected simple intracystic papillomatous tumours (of duct and acinus types) can be found in them, and in a recent case of Mr. Burghard's I found not only simple papillomatous tumours, one of which was the size of a capital O in this print, but an unsuspected cancer as well.

It seems to me perfectly fair to compare recent work on the changes in ovarian cysts with the changes I have described in the breast cysts. They will be seen to be identical.

I am indebted to Mr. Joseph E. Barnard for the trouble he has taken in photographing my specimens.

FOUR ANEURYSMS IN THE NECK.

By R. LAWFORD KNAGGS, Leeds.

The following interesting group of cases—(1) *A varicose aneurysm* (arteriovenous); (2) *Two traumatic aneurysms at the root of the neck*, treated by distal ligature; and (3) *One carotid aneurysm*, treated by proximal ligature—includes all the aneurysms in the neck with which the writer had to deal in the war.

It is well known that when arteriovenous aneurysm is met with in the neck it is less serious in its progress than the same condition in the extremities, especially the lower extremities. But it is not such common knowledge that spontaneous cure may result.*

Traumatic aneurysm at the root of the neck, however, is a more serious matter, and must always give rise to anxious thought before operative treatment is decided upon. It is true that such an aneurysm might be due to a wound of the transversalis colli, or possibly the suprascapular artery, and prove less serious than was anticipated; but as a rule it is either the subclavian, or one of the large branches of its first part, such as the vertebral, or the thyroid axis, close to their origin, or the carotid near the bifurcation of the innominate, that has been injured. In such cases any operation above the clavicle, whether ligature of the innominate or the first part of the subclavian, or excision or obliteration of the sac, involves surgical procedures of the gravest character, even if all goes well; but if complications arise—a not unlikely possibility—they may be attended with the most urgent dangers, and the surgeon may esteem himself fortunate if he is able to meet them successfully before the patient succumbs.

It was after a conversation with Mr. Jonathan Hutchinson that I first began to think seriously of the distal ligature. He had once tied the first part of the axillary artery for a spontaneous aneurysm of the subclavian, and had no reason to think that the patient had not remained permanently cured. My experience of the distal ligature was limited to its use in thoracic aneurysms, and what I had seen had not impressed me with its value, so that my feeling about it, then, was very much that voiced by Sencert, who speaks of distal ligature as a makeshift operation. But on a careful review of the 'pros and cons' it was evident that in suitable and properly-selected cases there was a good deal to be said in its favour.

My experience of the traumatic aneurysms that found their way over to England had taught me that the communication between the sac and the artery was usually quite small, and the aneurysm a well-marked saccular one. Such aneurysms, moreover, occurred in young soldiers whose arteries were healthy, a factor of some importance, for there was less danger of enlargement of the communication. The local conditions, therefore, were eminently favourable to consolidation of such a tumour if only the blood-stream could be sufficiently slowed and weakened.

So far as could be judged from the position of the swelling in *Case* 2, the communication between the sac and the vessel was likely to be in the second part of the subclavian artery. If a ligature were placed on the axillary artery in its first part, above the acromio-thoracic branch, a length of vessel almost without branches would intervene between the mouth of the sac and the ligature. The only branch of any importance would be the superior intercostal, and it would probably take some time before this would enlarge

* I believe a very similar case was shown at one of the Societies during the war, but I am unable to give the reference.

sufficiently to enable a strong blood-stream to flow past the aneurysmal opening. And it was just possible that the opening might be on the distal side of the origin of the superior intercostal. There was also another point, which would be of some moment if distal ligature were to fail and a more direct operation become necessary: ligature of the axillary artery would leave the tissues above the clavicle undisturbed.

For these reasons it was decided to employ the distal ligature in *Case* 2.

In *Case* 3 there was much greater uncertainty as to the position of the mouth of the sac—as to whether the subclavian, the carotid, or the vertebral had been wounded. This made it difficult to decide which artery to tie. The probable course of the metal fragment lying behind the sternum decided me to tie the carotid, and fortunately there has never been reason to regret it.

The last case calls for no particular comment. It was a question of judgement whether it would be more in the interest of the patient to complete the dissection and remove the sac or to tie the artery. As the aperture was likely to be small, success after proximal ligature seemed almost certain, and evidently the right decision was made.

PARTICULARS OF CASES.

Case 1.—**Arteriovenous aneurysm of common carotid artery. Varicose aneurysm. Spontaneous cure.**

Pte. F. S., age 23, received a shrapnel wound on the left side of the neck on Oct. 4, 1917, near Ypres.

During a short stay in the York Military Hospital, a visible aneurysmal swelling was noted, and he was transferred to a military ward in the Leeds General Infirmary, Dec. 5. On admission, there was a distinctly visible, pulsating swelling, as big as a filbert, opposite the left ala of the thyroid cartilage. The swelling ceased below at the level of the cricoid. There was a thrill over it, and this was very marked just above the swelling. There was a very loud, continuous whirring bruit, with systolic exacerbations, heard over the swelling and upwards over the vessels as high as the ear, and downwards along the course of the common carotid in the neck and over the first piece of the sternum. It ceased when the common carotid was compressed below the swelling. A skiagram showed a pointed piece of shrapnel opposite the 4th cervical vertebra, close to the bone on the left side, and just below the side view of the body of the hyoid bone. The cicatrix of the small wound of entrance was on the level of the body of the hyoid.

His only trouble was the noise of the bruit in his left ear when he lay with the left side of his head on the pillow. The heart's apex was normally placed; there was no cardiac bruit, and the second sound was accentuated.

The patient was put to bed, and the excitability of the pulsation which was present when he was walking about soon subsided. On Jan. 11 the swelling had not increased and was a little harder; the bruit was not so loud nor the pulsation so marked as when he came in, or when allowed out of bed, and the thrill was not felt. By Feb. 26 a further change was apparent. The intensity of the bruit had much diminished. It was doubtful even if it was continuous. There was a soft systolic murmur—rather distant—and the pause was of very slight duration. Yet on March 6 its continuous character was again recognized, but the area over which it could be heard had become very restricted. On April 9 no bruit had been heard for several days. The thrill was still absent. The swelling was no longer visible. It could be felt as a small hard swelling, no bigger than a pea, about the level of the middle of the thyroid cartilage. The pulsation connected with it was thought to be transmitted from the artery. On April 28 there was no pulsating swelling, no bruit, no thrill. A small mass of thickening was left which presented two spots of greater hardness, one of which was almost a nodule.

Recovery was now regarded as complete, and he was allowed to get up. With the exception of a few days at the time of his transference from York to Leeds, he had been in bed for about thirty weeks. On June 3 he was transferred to Gledhow Auxiliary Military Hospital (V.A.D.), and after a couple of months' convalescence he was invalided—apparently quite cured.

In the early part of 1920 he wrote that he was working in the pit, and it is evident from his letter that there had been no relapse.

Case 2.—**Traumatic aneurysm at the root of the neck. Distal ligature. Cure.**

Spr. G. H. B., age 26, was wounded on Sept. 26, 1915. A rifle bullet entered the back of his neck, passing through the right trapezius, and lodging, as was subsequently shown, behind the inner end of the right clavicle, one inch from the anterior surface of the neck.

On admission to the 2nd Northern General Hospital, Oct. 2, the wound of entry was not healed, but it gave no trouble, and the bullet-track closed aseptically. The patient was kept quiet and carefully watched for the possible development of an aneurysm; but it was not till Nov. 4 that

he drew attention to a swelling which had made its appearance only a day or two before, above the inner end of the clavicle. The swelling was about the size of a damson, and lay under the clavicular head of the sternomastoid. It was elastic, and pulsated, the pulsation being almost certainly expansile. There was a short systolic bruit heard over it. Some pain was experienced along the course of the ulnar nerve, but there was no sign of venous pressure. The swelling increased a little during the next week or two, till it became as big as a small bantam's egg. It formed a visible tumour and could be seen to pulsate. So long as the patient was kept completely at rest in bed it remained stationary, and was thought to become both smaller and harder. But when, after many weeks, he was allowed to get up, it soon became larger and more prominent, and he was again confined to bed. During the period of treatment by rest he also had weekly injections of horse serum, and chloride of calcium intermittently.

But at the beginning of May it became clear that cure could not be expected by medical treatment, and the man also wished to have an operation. On May 10, therefore, the first part of the axillary artery was tied about one-third of an inch above the origin of the acromiothoracic artery, after detaching the outer part of the clavicular origin of the pectoralis major, and drawing that portion of the muscle downwards and inwards. The wound healed by first intention, and on May 19, when the stitches were removed, the aneurysm was much less prominent, was smaller and much firmer, and no bruit could be heard. The third part of the subclavian could be felt to pulsate, and though the tumour pulsated, the pulsation was thought to be communicated and not due to expansion of the sac.

On June 14 it was noted that "though there is definite fullness below the sternomastoid, yet no pulsation has been visible since the first dressing. The tumour is firm, and about as large as a gooseberry. There is no bruit, but only a kind of thud. The transversalis colli artery can be traced by its pulsation across the posterior triangle. Feeble pulsation can be felt in the brachial, about the insertion of the coracobrachialis, and also in the radial".

In August, when he was discharged from the army, there was an indurated swelling, with some surrounding thickening, at the site of the original pulsating swelling, and there was every reason to believe that a cure had resulted. The man's home being in London, I got him to report himself at the London Hospital to Mr. Jonathan Hutchinson, who told me that when he last saw him he thought that he was quite well, and he had given him permission to do some work.

On March 3, 1917, the man himself wrote: "I am pleased to let you know I am going on very satisfactorily without the least trouble"; and again on March 7, 1920, that he had "been working pretty well all the way through", and was now driving a motor car. He had not had the slightest trouble with his neck.

Case 3.—**Traumatic aneurysm at the root of the neck. Distal ligature of the common carotid. Cure.**

Pte. W. F., age 19, received a gunshot wound of the neck on May 3, 1917. He was under treatment for paresis of the left (?) deltoid when he was transferred to the orthopædic department of the 2nd Northern General Hospital in July.

On July 29 he was transferred to a surgical ward for a pulsating swelling at the root of the neck, and was under the care of Captain G. P. Anning. The following notes were made:—

"On the right side of the neck there is a horizontal scar, 2 in. long, lying across the posterior triangle. Its anterior extremity is just behind the posterior border of the right sternomastoid muscle and 1½ in. above the clavicle. This is the entrance wound. There is the scar of an exit wound 1 in. to the right of the dorsal spine. A small ovoid swelling presses forwards the lower portion of the sternomastoid muscle, and presents behind its posterior border in the posterior triangle. It lies entirely external to the line of the carotid artery and reaches as low as the clavicle, and possibly passes beneath it. It pulsates, and the pulsation is expansile, and a sharp, harsh bruit can be heard over it and along the course of the subclavian and carotid arteries. There is no sign of pressure upon the big veins, nor at this date, of any interference with the branches of the brachial plexus."

Later, a skiagram revealed the unexpected presence of a piece of metal behind the first piece of the sternum, close to the left sternoclavicular articulation, which was located at a depth of 1¾ in. from the surface. There could be little doubt that this had traversed the tissues close to the bifurcation of the innominate. The tumour increased in spite of rest in bed, and on July 31 was described as a soft swelling, the size of half an apple—by no means all sac—and extending as high as the upper border of the cricoid cartilage. The sac itself was more prominent at the posterior border of the sternomastoid, and on the inner side of that muscle an artery could be felt, either the innominate or the carotid, but not a part of the sac.

On Aug. 1 the common carotid was ligatured above the omohyoid. At the first dressing (Aug. 5) the soft swelling had disappeared, the sac was decidedly smaller and gave a feeling of greater solidity, and the bruit was much less marked. Pulsation continued. By Aug. 28 there was no bruit. Pulsation was much less obvious on inspection, and on palpation it was doubtful if it was more than a transmitted one. The patient was now quite unconscious of the beating, which had worried him before operation.

On Dec. 11 there was no tumour, no pulsation, and recovery was apparently complete. Lieut.-Colonel Wardrop Griffith, who had seen the patient on several occasions, had regarded the condition as quite cured some time before this date.

Case 4.—**Traumatic aneurysm of the carotid. Proximal ligature of the common carotid. Cure.**

Pte. M., 2nd Coldstream Guards, was wounded on Dec. 12, 1916. When he came under observation in the 2nd Northern General Hospital on Dec. 27, there was a small wound over the left temporomandibular joint (of no importance), and another very small healed wound in the neck, 1½ in. below and behind the left angle of the mandible. In front of the latter wound was a pulsating swelling, the size of a chestnut. The pulsation was not expansile, and there was no bruit. The swelling was not rounded, and it extended backwards and inwards, and felt like a mass of inflammatory tissue. On Jan. 26, 1917, a short, sharp, systolic murmur had developed, and the pulsation was expansile. The external carotid felt thicker at its most superficial part, when compared with that on the other side, and the main swelling blended with this thickened part, lying on its outer side.

Operation, Jan. 27. Ether. Through an incision 6 in. long in front of the anterior border of the sternomastoid, the left common carotid artery was exposed, and a temporary ligature applied at the level of the cricoid cartilage. A dissection of the sac was made, and its whole anterior surface and sides were exposed. It extended from the level of the bifurcation to the posterior belly of the digastric, its upper limit being covered by that muscle. The matting of the parts was so firm and so considerable, and the difficulty of recognizing anatomical structures involved in it so great, that it was evident removal of the sac would be very difficult, and that important structures would be in danger of injury. Therefore, as compression of the common carotid completely stopped pulsation in the sac, this vessel was ligatured about the level of the lower border of the thyroid cartilage, and the operation concluded. The small fragment of metal which had caused the mischief was not sought for.

On Feb. 7 the wound was healed, the visible swelling caused by the tumour had disappeared, and so had the pulsation and the bruit. On May 14 the tumour had completely disappeared, only a little thickening remaining at its site. There was no bruit, and the condition appeared completely cured. He was recommended for reclassification.

THE CAUSATION OF APPENDICITIS.

By A. RENDLE SHORT, Bristol.

The facts with regard to the history of appendicitis, and its racial distribution, are so clearly defined and unusual, and the disease is so common and plays such an important part in modern surgery, that it is passing strange that we have come to no settled conclusion as to its causation. The problem looks so simple. When a disease leaps into extreme prominence within a decade or two, becomes an everyday occurrence in the hospitals of certain more civilized countries, and leaves the rest of the world alone, surely the riddle of its causation should not be hard to read. Yet it has proved so.

The method followed in this study is to present first the facts regarding the increase of appendicitis and its distribution; then to seek to elucidate the ultimate cause by correlating these facts with the various advances of modern civilization; and lastly, to inquire what actually precipitates an attack.

I. THE ALLEGED INCREASE OF APPENDICITIS.

There are three means by which we have attempted to deal with this question: (1) By a study of the literature; (2) By the statistics of the Registrar-General of deaths; and (3) By a series of hospital figures.

The Literature of Appendicitis.—The first recorded case appears to be that of Mestivier[1] in 1759. Three others were reported in France before 1808, and the first English case, published by Parkinson[2] in London, was in 1812. The derivation of abscesses in the right iliac fossa from perforation of the appendix was clearly laid down in 1827 by Mélier,[3] but for many years the general opinion was against the appendicular origin, and the true etiology was concealed under the term 'perityphlitis'. Between 1820 and 1840, 33 cases were reported; between 1840 and 1860, 102; these were fairly distributed between France, England, Germany, and North America. The epoch-making treatise that finally and thoroughly established the main points about the disease and its treatment was that of Fitz, of Boston,[4] in 1886, and he introduced the name 'appendicitis'. It was he, too, who declared the importance of early operation. There is some difference of opinion as to who first diagnosed the condition and proceeded deliberately to remove the appendix; the claimants are Krönlein[5] in 1884, Treves[6] in February, 1887, and Morton,[7] of Philadelphia, in April, 1887.

From this time onward, the annual literature has grown to enormous proportions, especially since 1900. Sir Frederick Treves in this country, and McBurney in America, were leading pioneers. The profession had already realized that the disease was common and important, but popular interest in it dates very definitely from the time when Sir Frederick Treves operated on King Edward VII for an appendicular abscess on the eve of his coronation. Since then appendicitis has been a household word, and everybody knows something about it.

Fuller details of the history of the disease are given by Kelly.[8]

Registrar-General's Returns.—A second method of verifying the alleged increase in the incidence of appendicitis is by a study of the Registrar-General's mortality statistics. This method, however, needs careful allowance for its many limitations. Unfortunately, appendicitis did not become a separately notifiable and recorded cause of death until 1901.

Following is death-rate from appendicitis per million living, for England and Wales:—

Year	..	Death-rate	Year	..	Death-rate
1901	..	.. = 38	1911	..	.. = 75
1902	..	.. = 45	1913	..	.. = 68
1903	..	.. = 52	1915	..	.. = 67
1905	..	.. = 57	1917	..	.. = 67
1910	..	.. = 66	1918	..	.. = 72

The number of deaths from appendicitis in 1918 was 2416, being 1298 males and 1118 females. The age of greatest mortality is between 5 and 15.

In 1913 the Registrar-General presented a special report on appendicitis, showing that there is no seasonal variation of incidence, but that there is a remarkable parallelism in various months and various years between the death-rates from appendicitis and from diarrhœa. In rural districts there was a slightly lower death-rate per million living than in towns, the proportion being 66 to 71. Bearing in mind the greater difficulties of getting early surgical treatment in the country, and therefore probably a higher death-rate, in all probability the true incidence of the disease would show a greater preference for the town population than these figures indicate; in 1913, therefore, the town was decidedly more liable to the disease than the country.

In 1917, however, the deaths are higher proportionately in the rural districts than in London.

	Deaths from Appendicitis	Total Deaths, All Causes	Proportion
London ..	268	63,406	0·42
Rural ..	461	95,997	0·48

This difference may very well be due to an equal incidence of the disease, but prompter operative treatment in the metropolis.

There is very little doubt, from hospital statistics and from experience in private practice, that the mortality from appendicitis is lower now than it was fifteen years ago. At that time the death-rate was probably over 10 per cent; nowadays it is well under 5 per cent. In 1912 the mortality at the London Hospital amongst cases of acute appendicitis was 4·3 per cent; at Edinburgh, from 1910 to 1913, it was 7·3 per cent. In 1905, the London Hospital death-rate was 17·2; at St. Mary's Hospital in 1903 it was as high as 30·5 per cent. This goes to show that there has been a much greater rise in the total number of cases of the disease between 1901 and the beginning of the war period than the mortality figures show. There must be quite five times as many cases of the disease recognized to-day as in 1901, when we take into account the rise from 38 to about 70 deaths, and also the marked fall in the death-rate. It is further quite clear that the privations of the later stages of the war period, 1917 and 1918, did not materially alter the incidence of the disease.

Hospital Figures.—A third method of checking the increase is by a careful analysis of hospital figures. Fortunately, the medical and surgical notes of cases at the Bristol Royal Infirmary have been excellently kept for fifty years past, and are a veritable mine of historical information. The Infirmary is the larger of the two general hospitals in Bristol, and drains not only the town but also the surrounding country, especially within a 20-mile radius. There have been no special conditions to alter the complexion of the admissions during the past fifty years, except that a more trivial type of case has steadily given place to a more serious.

The figures are given in the table on next page. It should be carefully observed that they do *not* include interval cases, appendicular colic, appendicular dyspepsia, and the like, but only cases of acute appendicitis with raised pulse-rate and temperature.

It will be noticed that there were a few cases even in 1880; that the great rise took place between 1895, when it was just beginning, and 1905; that since 1905 it has been fairly steady; that there was no drop, but rather an increase, during the years of privation towards the end of the war. This increase, however, may have been accidental. The medical profession sends in a much larger number of early cases now than formerly, and country doctors, who might have operated at home, were away at the war. On the other hand, it must be remembered that a very large number of men, and some women, between 18 and 45, liable to the disease, had been withdrawn from the civilian population.

Now, it may be argued that the increase between 1895 and 1905 does not correspond to a genuine increase of appendicitis in the district, for the following reasons.

1. *That appendicitis may have been seen, but not recognized as such.* It may be argued that Fitz's monograph was not published till 1886; that it might have been several years after that before the medical profession in Bristol realized the importance of the condition, and that the disease was not looked for. Consequently it passed by other names, 'gastritis', 'inflammation of the bowels', and the like.

It is quite certain that this objection is incorrect. I have gone through the 1880 notes, medical, surgical, and gynæcological, with great care. 'Appendicitis' is not once diagnosed, but there are two cases recorded as 'perityphlitis' and one as 'iliac phlegmon.' It is clear, therefore, that the condition *was* recognized, though under the older name. It is quite often mentioned in the notes, in cases of colic, gastritis, etc., that there was " no tenderness in the right iliac fossa ". Obviously 'perityphlitis' was being watched for. Further, I have gone carefully over the notes, usually full and excellent, of all the cases with abdominal symptoms, including a large number of patients with typhoid fever, some of peritonitis, diarrhœa, gastritis, colic, etc., and it is impossible to force them into being appendicitis. I allow one probable case, and four barely possible, but no more. All eight recovered; the iliac phlegmon was the only one operated on. In 1885 there are two cases diagnosed as 'peritonitis' which were quite probably appendicitis, and one very doubtful case recorded as 'intestinal colic'. All three recovered without operation. It should be understood that all the figures given, early and late, relate only to acute cases with a raised pulse-rate or temperature.

2. *That appendicitis was common outside the Infirmary, but that no special effort was made, as nowadays, to get the patients in.* At the present time, nearly every doctor in town and country hurries his appendix cases to a hospital, or summons a surgeon, as soon as they are recognized; before 1900, no attempt was made to do this.

BRISTOL ROYAL INFIRMARY FIGURES.

YEAR	NUMBER OF CASES OF PROBABLE OR CERTAIN ACUTE APPENDICITIS	ADDITIONAL VERY DUBIOUS CASES	TOTAL IN-PATIENTS TREATED
1880	4	4	2591
1885	2*	1	3370
1890	4	6	2913
1895	15	—	2910
1900	23	—	2865
1905	64	—	3762
1910	58	—	4149
1915	75	—	3481
1917	98	—	3907
1918	113	—	4021

* Some notes are lost, and an equivalent period of 1886 has been substituted.

Whilst so much must be admitted, it seems certain that appendicitis could not have been anything like as common in the community before 1900 as it is to-day. Quite forty per cent of patients with acute appendicitis not operated on would have a long and serious illness; many would die. Pressure on the Infirmary beds in those days was not severe; plenty of cases of syphilis, colic, bronchitis, and other mild conditions were admitted. Surely a great number of the poorer folk with perforated appendices would have sought admission, if they had existed.

It is easy to put it to the proof. Let us compare the years 1885 and 1915. In 1885 there were two cases of probable appendicitis and one barely possible case; all recovered without operation. In 1915 there were 75 patients with acute appendicitis. Let it be admitted that some of these were early cases who might have got well at home. Let it further be admitted that some of them were drafted in from the country, and that in 1885

this might not have occurred (though plenty of country patients used to be taken in, even then). But eliminating all these, we are left with 34 patients with a *perforated* appendix, drawn entirely from the city of Bristol. Making every allowance for the growth of the population, which was 206,503 in 1881 and 352,859 in 1915, it is quite clear that there must be an enormous rise in the incidence of the disease, because surely a considerable number of these patients, with a perforated appendix and resident in the city, would have resorted to the institution to be nursed through such a serious illness.

3. It may further be objected, *that in the earlier period appendicitis may have been treated more in private practice, but now mainly in hospital.* There is some evidence that the very poor suffer from this disease less than the better fed; before 1900 the poorer classes were ill-fed, and may not have suffered to the same extent.

This objection is more difficult to meet. Several old practitioners to whom I applied had no notes available. I am greatly indebted to Dr. Shingleton Smith, who was honorary physician to the Bristol Royal Infirmary from 1873 to 1905, for the figures of his private practice from 1885 to 1890. It should be explained, to give the record its proper value, that Dr. Shingleton Smith was then one of the busiest and best esteemed physicians in the city, with a good-class practice, and he divided with two or three others nearly all the private consulting work. He was also thoroughly alive to the existence and importance of 'perityphlitis' or 'appendicitis'. At that period such cases more commonly went to a physician than to a surgeon. At the Infirmary in 1885 and 1890 there were ten of these patients in the medical wards, and only three in the surgical.

Dr. Shingleton Smith saw in the five years six cases of possible or probable appendicitis, one of which died, and another was operated on by Mr. Greig Smith. It is not easy to gauge exactly from this what the incidence of the disease was in private practice as compared with the hospitals, but it seems certain that it could not be nearly as common as it is now. The present-day Bristol surgeons undoubtedly see well over a hundred cases a year between them in their private practice, and if the disease had been equally common in 1885, each of the three or four consultants, carrying on a family practice besides, must surely have seen many more than one a year. During the same period Dr. Shingleton Smith saw seven cases of tuberculous peritonitis. At the present time this disease is nothing like so common in Bristol as acute appendicitis. On the other hand, the average general practitioner to-day may not see more than a dozen cases in five years. Perhaps it is fair to conclude that in Bristol thirty-five years ago appendicitis was probably commoner amongst the well-to-do than amongst the hospital classes, but that it was not nearly as common as it is to-day.

THE DISTRIBUTION OF APPENDICITIS IN THE COMMUNITY.

As is well known, appendicitis may attack persons of any age and either sex, and no class in the community is altogether exempt. Occupational statistics do not appear to be available.

It is commonest between the ages of 10 and 30 (large figures analyzed by Kelly), but the Registrar-General's returns show the highest death-rates between 5 and 15, because appendicitis in children is relatively more fatal. It is rare under 3, but does occur; even within the first two months of life a few cases are reported. It is also rare in the aged, but has been seen at 78.

There used to be a marked disparity between the sexes, males being more liable. Many early figures gave the proportion as 3 male to 1 female. Of late years the difference has been less marked. In 1918, 1298 males died of the disease in England and Wales, and 1118 females.

It is quite common to find appendicitis running in families, and, making all allowance for chance and the frequency of the disease, it seems certain that some families have a special liability.

Evidence has already been quoted that the rise in the incidence of appendicitis was later in rural than in urban districts, but to-day there is little if any difference.

A very interesting question, to which only a partial answer can be given as yet, is the relative frequency of appendicitis in the Army and in men of the same age in the civilian population. Most surgeons who have had experience of the disease occurring in large civilian communities, and who also worked with troops during the war at base hospitals or casualty clearing stations, will probably agree that there was no excess of cases in the Army—possibly a smaller proportion than in a civilian population. The Registrar-General's figures for 1917 show: 620 deaths from appendicitis amongst 5½ million civilian males aged 15 to 45; 196 deaths from appendicitis amongst (? 2 million) non-civilian males. One can only guess at the number of members of the Army, Navy, and other forces in this country during 1917; every town and village seemed full of khaki. If it is taken as 1 million, the ratio of civilian deaths from appendicitis per million is to that of non-civilian as 112 to 196. If there were 2 million troops at home, as I think probable, the ratio is 112 to 98. If there were 3 million, the ratio is 112 to 65. Probably, therefore, there were fewer deaths from this disease amongst the troops than amongst civilian males of the same age. Earlier diagnosis and operation in the Army doubtless saved some lives; hence the true incidence is probably much about the same.

There is some evidence that the poorer classes in the community, or at any rate those living in institutions, show a relative immunity. Poor-law patients seldom come to hospital with it. At Portland Prison there was only one case in ten years. I have been impressed by the figures for the past five years of two more or less comparable communities with which I am acquainted. One is a public school with about 500 boys between eight and eighteen. They are liberally fed. There have been 19 cases of appendicitis.

The other is a children's home with an average of 950 inmates over eight (boys 350, girls 600). The larger numbers, and the fact that the home is full all the year round whilst the public school has two months' holiday, more than balance the fact that girls preponderate over boys. The diet consists of bread with margarine, treacle, or dripping, and porridge, daily, with milk; they get tinned meat and potatoes and cabbage on certain days, and fresh meat with vegetables once a week—broth and bread or rice on the other days; fruit, cake, etc., are occasional treats. The general health is excellent. There have been only four cases of appendicitis, all in girls. The disproportion, 19 to 4 in the same period, is very marked.

THE NATIONAL DISTRIBUTION OF APPENDICITIS.

Here we approach a very remarkable aspect of the question. As is well known, appendicitis is very rare amongst Asiatics and Africans, and is only common in highly civilized countries. Unfortunately the available information is still scrappy and disconnected. Much of it we owe to the labours of the late O. T. Williams,[9] of Liverpool.

Appendicitis in Europe.—The available information is as follows:—

Holland.—The death-rate for 1901 to 1904 was 88·8 per million. This would be high for England to-day; it was very high then.

Denmark.—The death-rate in 1914 was given as 12 per million. It is said that the people eat less meat, but more potatoes and rice. Also that they eat less vegetables than in England, but it is not clear what this refers to.

Sweden.—In 1905 the death-rate was 16 per million. The total number of operations throughout Sweden in that year, in hospitals, nursing homes, and private houses, was 2263. The diet included large quantities of potatoes, rye rather than wheaten bread, and much smoked and dried animal food.

Norway.—'Very frequent' amongst the well-to-do.

Spain.—Rather rare. The largest consultant in Madrid (just before 1914) saw only 4 cases in a year. The rich live like the French; the poor live on onions and other vegetables, and a thin stew of poor meat, bread, and rice.

Italy.—There were (about 1912) only about 156 operations a year in Rome for a population of 500,000, which, as Williams remarks, is much less than in Liverpool. In

Bristol there are probably more than twice that number (including interval cases), with a smaller population.

Greece.—Out of 28,000 in-patients, 393 were appendicitis. This is about one-third as many in proportion as we get in Bristol. The poor live on legumes, vegetables, and olive oil, with fish; but very little meat or bread and butter.

Finland.—Krogius[10] gives figures for the hospital at Helsingfors for the years 1901 to 1908. There were 89 cases in 1901, which rose to 237 in 1906, and 193 in 1908. The population is 137,000. The incidence seems rather higher than in Bristol.

Roumania.—Lucas-Championnière[11] in 1904 found only 1 case of appendicitis amongst 22,000 peasant patients, who live mostly on vegetables. The Roumanians living in towns, on a more liberal and meat diet, were frequently affected—1 case of appendicitis per 221 patients.

Appendicitis in America.—

United States.—The disease is exceedingly prevalent, as is well known. The death-rate per million population for 1900 was 97; for 1911 it reached 116. It is relatively much commoner amongst the whites than amongst negroes. Many doctors practising in the 'black belt' of Alabama can scarcely recall a case in a negro. The physician who acted as consultant to the Booker Washington school for 1400 coloured students had not seen a case; but at the Alabama Polytechnic Institute, where there were 400 black boys, there was an annual average of 8 cases. At the former school the diet is simple and the same for all; at the latter the cadets live at different boarding-houses in the town (Kelly).[8] At the Johns Hopkins Hospital, whilst of total admissions black form one-fifth, the number of cases operated on for appendicitis is 12 white to 1 black.

West Indies.—Cleaver states that in Trinidad there are many cases in whites, not one in negroes, though of the population 290,000 are black and only 4000 white. In Jamaica it is very rare in primitive negroes, fairly common in negroes who live in white style (Murray).[12] A missionary from Barbados tells me that in ten years he has never heard of appendicitis in a negro, but frequently in whites, although the population is composed of 12 black to 1 white. Sugar-cane is the staple food of the black; they chew it all the time. Babies are often brought up on sugar and water instead of a proper quantity of milk.

Appendicitis in Asia.—

India.—It is almost absent in villages, fairly often seen in towns (Murray).

China.—Jeffreys and Maxwell[13] state: "The disease is relatively very rare. Reports are to hand from many parts of China on the subject, and all agree that the disease is very uncommon. It is probably a liberal estimate to state that there is not more than one case in 2000 hospital in-patients amongst the Chinese. The disease is, however, frequently seen amongst foreigners." The Chinese live on two meals a day of rice and vegetables. Pork is dear, and meat and fish they seldom get. Diarrhœa and other digestive diseases are common.

Persia.—It is very uncommon in natives, often seen in Europeans. The natives live on wholemeal bread, some meat, rice, and a great deal of fruit, lettuce, cucumber, beet-root, and cheese. Everything is cooked in fat. Reports from sixteen doctors show 57 cases amongst 54,000 patients, and of these 9 or more were Europeans. One old resident said he had seen more appendicitis amongst 100 Europeans than in 200,000 Persians (O. T. Williams).

Appendicitis in Africa.—

Morocco.—A doctor reports only 2 cases in sixteen years, but several in whites (Murray).

Nyassaland.—Four cases in whites, none in 5000 natives.

Central Africa.—Dr. Fisher, of Kalene Hill, who has been nearly thirty years in Africa, tells me he has very seldom seen appendicitis.

Abyssinia.—Dr. Wakeman, M.O. to the British Legation, reports no cases in eight years. The food is a small-grained cereal; they also eat raw beef, mutton, game, and legumes, with much melted butter.

Zanzibar.—Waller[14] states that "acute appendicitis in an African native, if not unknown, is, I believe, exceedingly rare." He narrates a case in a native ayah living on English food.

Egypt.—Dunn[15] saw 2 cases in six years at Luxor. The natives live on fish and vegetables.

Johannesburg.—Appendicitis amongst Rand natives is almost never seen (Pitchford, quoted by Shattock[16]).

Madagascar.—Peake[17] saw only 3 or 4 cases a year in 15,000 to 25,000 patients. The native diet is mainly rice and herbs, with a fair amount of beef and pork.

Appendicitis in Polynesia.—

Solomon Islands.—Crichlow[18] had not seen a case in a native in five years, but a native girl living as a European in an Englishwoman's home got it.

New Guinea.—W. M. Strong reports having seen in ten years one case in a white, one in a native who took to European food, and one in a raw native.

It is very unfortunate that the medical reports issued by the Colonial Office do not record appendicitis under a separate heading. This ought to be remedied.

APPENDICITIS IN ANIMALS.

The disease appears not to occur in animals in the wild state, but it is quite common amongst apes in captivity. At the London Zoo there were two cases in gibbons and one in a chimpanzee, verified at autopsy. There were 15 cases of inflammation in the cæcum or cæcal appendages of various other animals (Murray). Weinberg[19] reports that 10 out of 61 post-mortems on chimpanzees in captivity showed appendicitis.

Some experimental evidence will be referred to later.

SUMMARY.

Let us now gather together the threads of our problem by stating the facts that demand an explanation.

1. Appendicitis was present, but was relatively rare, in this and other countries until the end of the nineteenth century. Since then it has become very common in most highly civilized countries.

2. The rise, in Bristol and probably throughout England, was beginning in 1895, and was pronounced between 1895 and 1905, since when it has been fairly stationary.

3. The rise was more marked, at first, in towns, in the male sex, and, probably, amongst the better-off classes.

4. Inmates of institutions on a somewhat plain diet are relatively immune.

5. The privations of the war did not reduce it.

6. Soldiers were not unduly affected; possibly they were slightly less liable.

7. In spite of gaps in our evidence, it is clear that the national distribution is very unequal. In the United States, Great Britain, probably France and Germany, Holland, and Helsingfors, the incidence is high. In Denmark and Sweden it is lower. In Spain, Greece, Italy, and the rural parts of Roumania it is low.

8. In Asiatics, Africans, and Polynesians it is very rare, unless they take to European food; then it becomes common.

9. In wild animals it is rare or absent. In animals in captivity it is common; this specially applies to apes.

II. THE ULTIMATE CAUSE OF APPENDICITIS.

The medical press has witnessed at times a lively discussion as to the reason for the increase of appendicitis, and all sorts of suggestions, possible and impossible, have been made. It was alleged, for instance, that the use of enamel ware for cooking is responsible; but inasmuch as bits of the ware are seldom if ever found in the appendix, even if a concretion is present, the theory is quite baseless. Someone suggested that the use of

water-closet seats instead of squatting for defæcation is to blame. The late Dr. Charles Mercier was so moved to scorn by the plethora of baseless speculations that he propounded the theory that it was due to the abandonment of wig-wearing—there were no cases recorded from the days of Charles II, when wigs came in, till the end of the eighteenth century, when they went out, except for judges, barristers, and Victorian bishops. He knew of no cases in legal luminaries, and "who ever heard of appendicitis in a wigged bishop?"

Many are satisfied to regard the disease as the product of "the advances of civilization". No doubt this statement includes the truth, but all the same it deserves to be vigorously combated. It is vague, largely untrue, quite unscientific, and useless in practice. It is untrue, because civilization as such was *not* new-born in 1895. It is unscientific, because the analogy of other diseases—enteric fever, malaria, scurvy, rickets, and a score besides—shows that the causation of disease is not something vague and diffuse, but definite incidents or habits. It is useless, because we cannot put off our civilization from us. The phrase is a cover for slipshod thinking.

By far the most probable explanation is that the rise in the incidence of appendicitis is due to some change in the food habits of the people. The appendix is part of the alimentary canal, and is therefore directly affected by diet. The period 1890 to 1905 was characterized by an immense increase in the imports of quite a number of foodstuffs into this country, as we shall see, so much so that the national diet must have been greatly altered. Europeans in the tropics retain their liability to the disease. It is highly significant that institution diet does *not* predispose to the disease; that reports come from the United States, West Indies, Zanzibar, the Solomon Isles, and elsewhere, that natives or Africans taking to European food are liable to the disease, but Africans, Asiatics, Polynesians, and the peasants of Spain, Roumania, and Greece are relatively immune. Countries where the diet is more modern, such as England, Holland, and the United States, suffer more than Italy and Scandinavia. Lastly, apes in captivity share the penalty of civilized food-habits. Our problem, therefore, begins by passing in review the use of the principal foodstuffs, and especially imported foodstuffs, because it is from amongst these that the newer dietary has largely been constructed. The old England used to feed herself; modern England, as the war has taught us, gets most of her food from overseas.

The principal imported foodstuffs[20] are wheat and other grains, meat, butter, tea, coffee, cocoa, sugar, rice, bananas, oranges, currants, and raisins.

Wheat, Flour, and Grain need not be taken into account as directly giving rise to appendicitis. Such a theory would be incompatible with the facts to be explained. We must, however, notice the suggestion made by Battle[21] that the rise in the incidence of the disease is due to the substitution of iron rollers for the older stone mills to grind flour. He brought forward in evidence six appendices that showed black pigmentation of the mucosa, attributed to deposition of iron dust derived from the rollers, converted by putrefactive gases into ferrous sulphide. Shattock,[16] however, advances chemical proof that the black pigment is not iron. He remarks that if the theory were true that enamel-chips from cooking vessels gave rise to inflammation of the appendix, dust from the old stone rollers should have induced it. In each case the chips or dust would be composed of silica, and be insoluble in the digestive juices. In the Transvaal, where pneumonokoniosis is so prevalent, there is no undue prevalence of appendicitis amongst the white miners, and the natives are practically immune.

The discussion is not without value, as showing how many complicated by-ways of food-production need to be explored to get at the cause of appendicitis.

Butter.—This cannot be the cause. Plenty of butter was eaten in old England before the disease became common. During the later years of the war, very little butter has been available for anybody, but there has been no falling off in appendicitis cases. The consumption per head of imported butter in the United Kingdom is given in the following table. It is charted alongside of the appendicitis curve at the Bristol Royal Infirmary in *Chart I* (*Fig.* 116). The question of chemical preservatives will be considered later.

Tea cannot be accused of causing appendicitis, if only by reason of the immunity of tea-drinking people like the Chinese. The rise in consumption during the critical period is not great. (*See Chart II, Fig.* 117.)

Coffee must be exonerated. The consumption per head in 1890 averaged 0·75 lb. per annum, and in 1914 it had dropped to 0·63.

Cocoa.—It would be possible to make out a case against cocoa and chocolate. There has been a steady and considerable rise in consumption over the period in question, from 0·3 lb. per head in 1880 to 1·2 lb. in 1914. Cocoa and chocolate are a civilized taste, and they are much favoured between the ages of five and thirty. Inmates of institutions would get less chocolate, if not less cocoa. Its use did not lessen during the war; nor did appendicitis. (*See Chart I, Fig.* 116.) At the same time, it does not seem probable that the key to the problem lies here. The rise in consumption between 1895 and 1905, the critical period, is only from 0·62 lb. to 1·1 lb., which does not seem great enough. There is no apparent reason *why* cocoa, or chocolate apart from its sugar-content, should upset the alimentary canal. It would scarcely explain the prevalence in apes in captivity, unless they are pampered with more chocolate than one would expect.

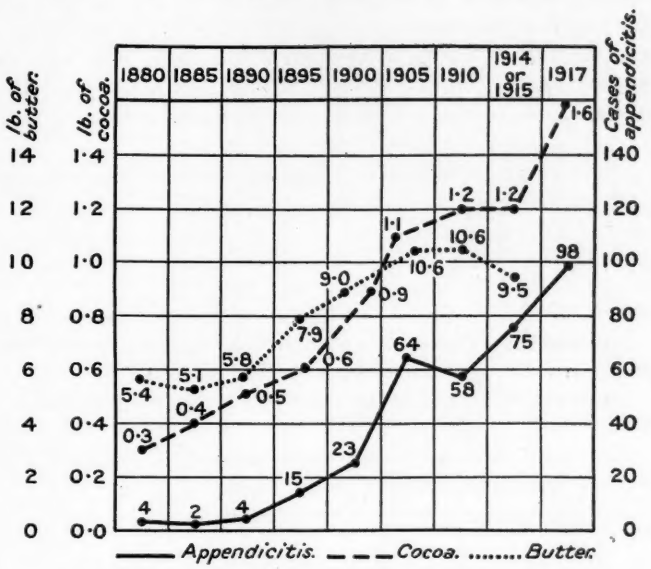

FIG. 116 (CHART I).—Showing (*a*). The average annual consumption of *imported butter*, in pounds per head of population of the United Kingdom; (*b*). Ditto of cocoa and chocolate, expressed as *raw cocoa imports*; (*c*). Number of cases of acute appendicitis at the Bristol Royal Infirmary.

Table I.—CONSUMPTION OF IMPORTED BUTTER, COCOA, TEA, AND SUGAR, IN POUNDS PER ANNUM, PER HEAD OF POPULATION.

	IMPORTED BUTTER	RAW COCOA	SUGAR	TEA
1880	(5·4)*	0·30	63·4	4·6
1885	(5·1)*	0·40	74·2	5·0
1890	5·8	0·54	73·2	5·2
1895	7·9	0·62	87·9	5·6
1900	9·0	0·92	87·3	6·0
1905	10·6	1·1	74·4	6·0
1910	10·6	1·2	83·4	6·4
1914	9·5	1·2	95·7	6·9
1917	—	(1·6)†	(63)†	(6·0)†

* The Board of Trade returns include margarine, probably about 2 lb., with butter, given as 7·4 and 7·1.
† My estimates deduced from published figures: only approximate.

Sugar may be dismissed the court. There has been a steady rise in sugar consumption per head during the past forty years, but there was no rise between 1890 and 1905, the critical period; the consumption fell away to the 1880 figure towards the end of the war; and, as has been mentioned before, the negroes of Barbados almost live on sugar but do not get appendicitis. (*See Chart II, Fig.* 117.)

Rice cannot be blamed. It is the staple food of the Chinese and many Indian races. There has, however, been a moderate rise in its consumption in this country, from 9 lb. per head in 1890 to 14·6 lb. in 1914.

Bananas.—A banana theory of appendicitis has been put forward and defended by Stephens.[22] He maintains that most civilized countries started to import bananas in great quantities just about the time that the incidence of the disease rose, partly in consequence of a Government subsidy from 1901 onwards. He points in confirmation to the relative immunity of those who are too poor to buy bananas. The suggestion, however, can scarcely be accepted. The main rise was too late to fit the theory, and the great drop in imports during the war has not abated the course of appendicitis. Natives of the West Indies get plenty of bananas but no appendicitis.

Table II.—Imports of Bananas into England and Wales.

Year	Bunches	Year	Bunches
1884	10,000	1910	6,000,000
1900	1,300,000	1914	9,000,000
1905	5,700,000	1917	2,200,000

Oranges.—The number imported has only risen from 3 million to 5 million cwt. since 1895, so this cannot be the effective cause.

Currants and Raisins may safely be exonerated. Consumption has actually fallen, from 4·7 lb. per person in 1890 to 4·5 lb. in 1914.

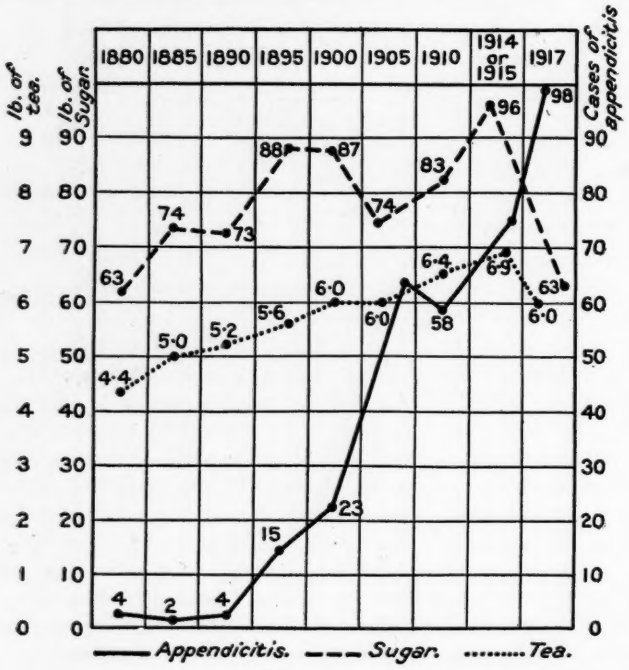

Fig. 117 (Chart II).—Showing (*a*). Annual average consumption of sugar per head of population of United Kingdom, in pounds; (*b*). Ditto of tea; (*c*). Cases of acute appendicitis at the Bristol Royal Infirmary.

Meat.—There is much to be said for the widely accepted view that meat-eating is the cause of appendicitis. The national distribution of the disease is strongly in favour of the theory. In the main, the meat-eating races suffer, and the more or less vegetarian Chinese, Indians, and Africans escape. Southern Europe is less affected than Northern Europe, and less meat is eaten in the southern countries. The Polynesians eat much fish, but not much meat, and they escape. Then again, before 1900 there used to be a very large class in this country who lived in abject poverty, and could not get meat; things have mended very much in this respect during the past twenty years. Dr. O. T. Williams,[9] before his lamented decease at an early age, put together a valuable body of evidence supporting this view, which has already been largely drawn upon. He demonstrated that the appendix mucosa and concretions in cases of appendicitis contain calcium soaps and other insoluble compounds of the saturated fatty acids. This has been confirmed by Bertha Anthony[23] in America. Williams maintains that olein is almost fully absorbed (98 per cent) from the intestine, but that stearin is very imperfectly absorbed (9 to 14 per cent). He believes that the fatty acid compounds may be unabsorbed residue

from saturated fat in the diet, and the principal source of such fat would be meat. He believes that there has been a great increase in the amount of meat eaten in this country, and points to the immense growth of the imports of frozen and tinned beef and mutton. Murray[12] continued the investigation by adding fresh evidence from more or less vegetarian countries where there is very little appendicitis.

One may accept the demonstration that calcium soaps, etc., are present in the chronically inflamed appendix, without necessarily conceding that the fatty acids are derived from non-absorbed fat of meat. It is well known that it is common for chronically inflamed or degenerating tissues to develop considerable quantities of fat in visible form. All the fatty degenerations of pathology are instances of this. If it is the *fat* of meat that is at fault, it is curious that children, who so often dislike meat fat, are principal sufferers from the disease. Also, appendicitis may occur in vegetarians. I have made no special inquiry as to my patients' diet, but I know one was practically a vegetarian.

The crux of the matter, however, turns not on isolated personal experiences or on doubtful points in chemical pathology, but on the larger data furnished by big communities. Was there a great increase of meat-eating between 1895 and 1905? Will the theory explain the distribution of appendicitis?

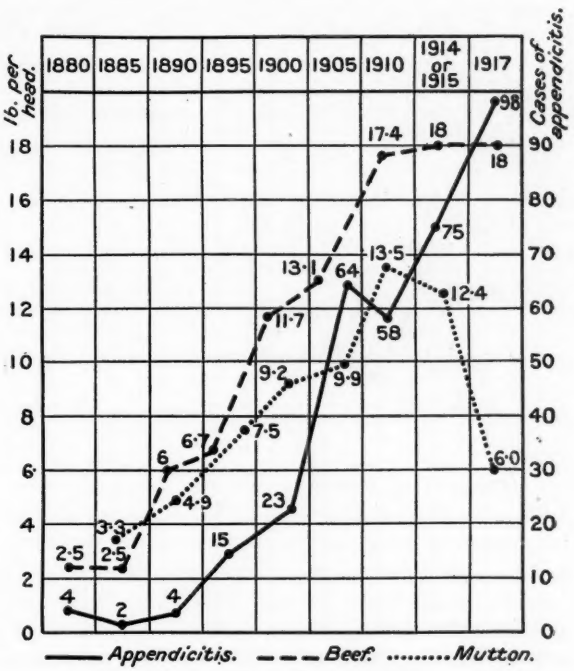

FIG. 118 (CHART III).—Showing (*a*). Average annual consumption of *imported beef* in pounds per head of population of United Kingdom; (*b*). Ditto of *imported mutton*; (*c*). Cases of acute appendicitis at the Bristol Royal Infirmary.

At first sight, the correspondence between meat-consumption and appendicitis seems remarkably close. The parallelism, for instance, between the appendicitis curve and the imported beef curve shown in *Chart III* (*Fig.* 118) is so striking that it would appear that our problem is solved right away, and it must be allowed as practically certain that there is a relation between the two, indirect if not direct. The consumption per head of the population for imported beef rose from 2·5 lb. in 1880 and 1885

Table III.—TO SHOW ANNUAL CONSUMPTION OF IMPORTED MEAT PER HEAD OF POPULATION, FOR UNITED KINGDOM, IN POUNDS.

YEAR	BACON AND HAM	BEEF, SALTED, FROZEN, FRESH, ETC.	MUTTON, FRESH, FROZEN, ETC.	BEEF FROM LIVE IMPORTED CATTLE	MUTTON FROM LIVE IMPORTED SHEEP
1880	15·9	(2·5)*	—	(5·8)*	—
1885	11·5	(2·5)*	(3·3)*	(5·8*	(1·0)*
1890	13·5	6·0	4·9	11·1	(0·6)*
1895	14·6	6·7	7·5	8·1	(1·3)*
1900	19·5	11·7	9·2	9·2	(0·6)*
1905	17·4	13·1	9·9	9·5	0·26
1910	11·2	17·4	13·5	3·2	—
1914	14·2	18·0	12·4	—	—
1917	18·0	(18·0)*	(6·0)*	—	—

* Rough figures calculated from published returns.

to 17·4 lb. in 1910, and it doubled in the critical period, 1895 to 1905. The curve for imported mutton is almost as striking, though it shows a big drop in 1917. Expressed in another way, imported beef—frozen, fresh, salted, etc.—rose from 1 million cwt. in 1880 to 2½ million cwt. in 1890, nearly 6 million cwt. in 1905, and 9½ million cwt. in 1914. Mutton rose from 1,734,000 cwt. in 1890 to 3,841,000 cwt. in 1905, and 5,260,000 cwt. in 1914.

This remarkable increase might be directly related to the appendicitis figures in one of two ways; either the *preservation* of the meat may be harmful, or the increase in the total quantity eaten. These must be considered separately.

Table IV.

Year	Population of United Kingdom	Resident Cattle	Resident Sheep	Consumption* per Head of all Imported Meats, Dead or Alive, in lb. per Annum
1880	—	5,900,000	26,600,000	—
1885	36,300,000	6,600,000	26,500,000	24·1
1890	—	6,500,000	27,000,000	36·1
1895	39,200,000	6,300,000	26,000,000	38·2
1900	—	6,800,000	26,000,000	50·2
1905	42,900,000	7,000,000	25,000,000	50·1
1910	—	7,000,000	27,000,000	45·3
1914	46,000,000	7,100,000	24,000,000	44·4
1917	—	—	—	42·0

* My calculation from Board of Trade returns.

Question of Preserved Meat.—Everyone who served in the Army, especially overseas, will agree that a principal difference between Army diet and home diet was the quantity of preserved meat served out to us in the former. Bully beef, veal loaf, frozen beef or mutton, or Maconachie ration was our daily fare, especially the tinned foods. Therefore, if the increase in appendicitis is due to the use of these articles, the Army and Navy should have suffered very badly. But there is no evidence that they did. As far as I am aware, no publications have called attention to any undue prevalence of appendicitis. Personal experience is that the incidence was normal or subnormal. The Registrar-General's mortality figures for non-civilians in 1917 are probably lower than those for the same class of civilian men.

Preserved meat could not be the cause of the prevalence of appendicitis amongst apes. Institution diets contain more of it, relatively, than fresh meat, yet institutions are less liable to the disease.

If it be maintained that it is not tinned but frozen meat that is to be blamed, it becomes difficult to explain the high incidence amongst Europeans in the tropics where there are no public refrigerators to store frozen meat pending distribution.

Question of Increase in Total Meat-eating.—O. T. Williams, Murray, and others have attributed appendicitis, not so much to the use of preserved meat, but to the consumption of a relatively large total quantity of all meats. If this is to be accepted, it must be proved that much more meat is eaten nowadays in England than used to be the case, and that the main rise took place between 1895 and 1905.

Certainly it is true that there was about that time a great development of the trade in imported beef and mutton, frozen, salted, or otherwise preserved. America started sending us meat in 1876 (only 5513 tons), Australia about 1881, and the Argentine in 1889. In 1905 only 21·7 per cent of our meat was home-produced. In 1888 there were only 57 meat-ships; in 1908 there were 190. But this has not been the only source of meat. Three other factors enter into the problem. The first is the importation of live cattle and sheep for slaughter. This trade was considerable before 1890; even in 1875 265,000 cattle and 985,000 sheep were brought in. It rose till 1905, then fell away, and

since 1912 it has practically died out. The second factor is our supply of home-fed beef and mutton. Now for many years past, say since 1885, there has been almost no change in the number of the flocks and herds in this country—about 6½ million cattle and 26 million sheep. It is therefore evident that the home-grown meat supply has remained stationary, whilst the population has risen from 36 million to 46 million. So there has been a drop in consumption. The third factor concerns bacon and ham. Here there have been great annual fluctuations, but on the whole no great change in consumption from 1880 (15·9 lb. per head) to the beginning of the war (14·2 lb. per head).

I have recalculated the consumption per head of all imported meat, dead or alive, including beef, mutton, bacon, and ham. The result is given in *Table IV* and *Chart IV* (*Fig.* 119). There was a rise, truly, from 1885 to 1900; since that time, up to 1914, the high level was scarcely maintained. But the rise in the critical years, 1895 to 1905, was only from 38·2 lb. to 50·1 lb., and in 1917 it fell to 42·0 lb. All this time the consumption of home-grown meat was falling (since it was stationary on a rising population). During 1918 we had severe meat-rationing, nominally 12 oz. per week, but this did not check appendicitis, although it seems certain that the civilian population in 1918 got less meat than in 1895.

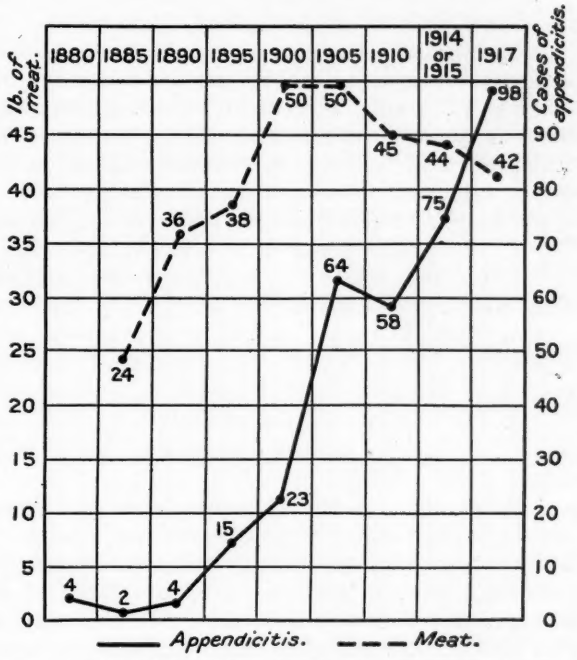

FIG. 119 (CHART IV).—Showing (*a*). Average annual consumption of all forms of imported meat in pounds per head of population of United Kingdom; (*b*). Cases of acute appendicitis at Bristol Royal Infirmary.

But the problem may be considered from another point of view. Admitting that thirty years ago many people got very little meat, there was even then, and always has been, a large minority of farmer families, well-to-do folk, soldiers, and others who got quite as much as the same classes do now. Our old songs sang the praises of the "Roast Beef of Old England", and contemporary records tell us of gluttonous feasts. In 1889 the official ration for soldiers in the British Army included 12 oz. of meat daily, and 1 lb. of bread. Brigade-Surgeon Maunsell[24] weighed 1232 rations, and found that the average amount of cooked meat issued, exclusive of bone and dripping, was 7 oz. 1 drachm daily per man. In a report to Parliament, also in 1889, the manager of Pearce's Dining-rooms showed that the firm fed 30,000 carmen daily, and that they consumed daily for dinner 5 oz. of meat, weighed uncooked without bone. Clearly, there were millions of people in England eating as much meat as anyone does to-day, and far more than civilians could get in 1918. If meat-eating were the cause of appendicitis, there should have been quite enough before 1890 to make it a common disease, and it should have almost died out in 1918.

Meat-eating will not explain the incidence of appendicitis in captive apes. When the national distribution of the disease is studied, it will be seen that races who are almost immune vary very much in the amount of meat they eat. In Persia, Abyssinia, and Madagascar they apparently take a fair amount.

The Question of Dental Caries or Nasal Sinusitis.—It has been maintained that carious teeth, or suppuration of the accessory sinuses of the nose, may be responsible for appendicitis. Neither of these can be taken seriously until it is shown, which is unlikely to be the case, that there was a marked rise in the occurrence of these ailments between

1895 and 1905, and even then we should have to trace the cause of that rise. It is not denied, however, that sinusitis, like tonsillitis, may be the proximate cause of an attack.

The Question of Food Preservatives.—The extensive use of boracic acid and other antiseptics as preservatives for foods began about the year 1880, though of course they had been employed to some extent previously. A good deal of attention was paid to the subject between the years 1896 and 1901, and a Departmental Committee appointed in 1899 reported in 1901.[26] They found that these articles were very largely used in milk, cream, butter, margarine, ham, bacon, and pork pies. Analysis showed that 18 per cent samples of milk, and 57 per cent samples of butter, contained them, boric acid being far more used than any other. The figures are available for Birmingham for four years, 1896 to 1900, but there is no great variation. Much more boric acid was used in summer than in winter.

Shortly after the report was published, the amount of preservatives allowed in butter and cream was regulated by the Local Government Board, and its use in milk prohibited altogether. I am informed by a leading dairy expert that during the past ten years very little boric acid or other antiseptic has been used in milk or butter, but that it is still present in bacon. In Denmark its use in foodstuffs was prohibited entirely. There is not sufficient evidence to show whether boric acid can be blamed for the increase in appendicitis. I think not, for the following reasons :—

1. The preservative came into extensive use too early, 1880 to 1895.

2. Children under five take most milk, and therefore should suffer most, but appendicitis does not become common till after that age.

3. There has been no fall in appendicitis corresponding to the lessened use of boric acid of late years in milk. Appendicitis has multiplied fivefold between 1901 and to-day, but there has been little if any increase in boric acid contamination.

4. The disease is common in the farming community, in Europeans in the tropics, and in Denmark, although in each of these little if any boric acid would probably be taken.

What, then, is the Ultimate Cause of Appendicitis ? There was a time when every disease in which diet played a part was thought to be due to something the patient had taken—dyspepsia, typhoid fever (milk-borne), gout (after a public dinner), ptomaine poisoning, asthma, and the like. Recently we have become aware of diseases due not to an excess but to a deficiency. One may instance scurvy, rickets, beri-beri, pellagra, and tetany. As we have failed to find irrefutable evidence that appendicitis is due to an excess of any one article, shall we explore the possibility that it is a deficiency disease ?

Our tables have clearly demonstrated that during the past thirty years, and especially between 1890 and 1905, the dietary of England underwent a radical change by the importation of greatly increased quantities, not of one foodstuff but of many. Preserved meats, butter, tea, cocoa and chocolate, rice and bananas, have all gone up. The importation of wheat rose immensely at the same time—60 million cwt. in 1890 and 97 million cwt. in 1905. Potatoes rose from about 2 million cwt. in 1890 to 3½ million cwt. in 1905. What does all this mean ? It means, infallibly, that older home-grown foodstuffs have been more or less crowded out by the newer, more tasty, or more nourishing imported articles. Swedes, turnips, carrots, parsnips, leeks, asparagus, cabbage of various sorts, rhubarb, lettuce, celery, the coarser fruits and vegetables, oatmeal porridge, rye, barley or other flours—in a word, the cellulose-containing foods—have been replaced in the dietary. It is not necessary to prove that the average Britisher eats less, absolutely, of any or all of these than did his forefathers. That is probably true—I think there has been a marked falling off in the consumption of cellulose—but it would be difficult to prove. The point is, that *relatively to the total food eaten*, cellulose-consumption has fallen, and this has been mathematically demonstrated by the figures given, showing a rise in the personal use of meat, rice, cocoa, chocolate, sugar, and the rest. The consumption of wheaten flour in bread, and especially in cakes and pastry, has also risen, so has that of potatoes. Modern

white bread contains less cellulose than the older browner breads. If a man took porridge for breakfast; soup, turnips, cabbage, and potatoes for dinner; and brown bread and butter and lettuce for tea in 1890, the bulk of cellulose in his total food has been reduced if he now adds bacon, Australian meat, and cakes to his meals, even if he does not drop out the porridge, greens, brown bread, and lettuce.

Let us see how this theory will fit our facts.

1. The time-criterion is correct. It was between 1895 and 1905 that the great dilution occurred, and then appendicitis had its increase. Since then the dilution and the increase have both been much less marked.

2. The cellulose foods would be in favour longer in the country than the town, but nowadays country diet and town diet are much alike. The appendicitis rise began in the towns.

3. In institutions, the older, simpler, and cheaper foods are still used, and are less diluted.

4. Apes in captivity do not get the coarse fibrous foods they did in the wild state.

5. During the later stages of the war, in spite of various privations, there was no great return to the old coarse foods. People ate less, but of the foods they were accustomed to. Soldiers got 'pork and beans', Maconachie ration, and often fresh vegetables to protect them.

6. The national distribution of appendicitis is much in favour of the theory. Almost every report from countries where the disease is seldom seen amongst natives lays emphasis on the fact that they partake largely of vegetables and other cellulose-containing foods. When individuals take up European habits, they drop their coarser articles of diet.

7. There is some direct experimental evidence on the subject. Von Knierien[25] showed in 1885 that rabbits fed on a cellulose-free diet develop inflammation of the intestines, and especially of the cæcum, which may be fatal. This does not occur in carnivores, whose cæcum is usually small. Apparently the effect is mechanical, because horn-shavings suffice to avert the trouble. Cellulose, of course, is mainly unaffected by the digestive processes.

It is of course possible that some 'vitamines', so-called, may be bound up with the cellulose. McCarrison[27] showed that autoclaving their food produced in monkeys marked distention and congestion of the intestines, colitis, loss of lymphoid tissue, and invasion of the mucosa by bacteria.

The following table, from Bunge,[28] gives the cellulose content of some foodstuffs :—

Table V.—Percentage of Cellulose in Some Dried Foods.

Wheat Flour .. 0·4	Spinach .. .. 8·1	Asparagus 17
Rice .. .. .. 0·7	Green Peas .. .. 8·7	Cabbage 18
Wheat .. .. 2·9	Carrots .. .. 8·8	Strawberries 19
Potato .. .. 3·1	Apples 10	Melon 22
Lentils.. .. .. 4·1	Radish 12	Pears 25
Beans .. .. .. 4·1	Cauliflower 13	Raspberries 47
Onion .. .. .. 5·0	Cucumber 14	

III. THE PROXIMATE CAUSES OF APPENDICITIS.

Whatever may be the underlying cause, new in the history of medicine, which during the past twenty-five years has been making the appendicular mucosa of civilized people more prone to inflammation, we have further to inquire, granted such a predisposition, what may bring on an individual attack.

1. **Relation to Other Diseases.**—At a large public school in Bristol, there has been noticed over a great number of years a remarkable seasonal association of one or two cases of appendicitis with epidemics of feverish colds and attacks of pharyngitis or tonsillitis popularly called 'influenza', but probably not the same as true pandemic influenza. Krogius[10] comments on the same association in Helsingfors. True pandemic influenza does not seem to act in the same way. There was no special outcrop of appendicitis in

Bristol after the terrible visitations of 1918, and I have only come across one record of any such sequel, described by Hall and Dyas.[29] They report that, after the influenza had visited a soldiers' camp in the States, the incidence of appendicitis rose from 10 per 1000 annually, its previous rate, to 44 per 1000. The outbreak lasted two months. Only one-third of the victims had suffered from influenza themselves.

Dr. Fortescue-Brickdale has kindly prepared for me a table showing the epidemic incidence of measles, mumps, and the other zymotic diseases in the above public school, but there is no relation to appendicitis.

Poynton and Paine[30] found streptodiplococci, apparently identical, in the tonsils and appendix of a case of acute appendicitis, and inoculation of a culture into rabbits produced appendicitis as well as arthritis in one-sixth of the inoculated animals. Adrian[31] in 1901 abstracted a good deal of German research showing that appendicitis may be produced in animals by injecting various organisms, such as strepto- or staphylococci or *B. coli*, subcutaneously.

We conclude, therefore, that throat infections may light up a latent appendicitis into activity.

Constipation, diarrhœa, and other digestive troubles do not, *per se*, cause appendicitis. For instance, they are very common amongst the Chinese.

2. **Trauma.**—There are plenty of cases in the literature in which a blow has started an acute attack. I have seen two such incidents. But there is no doubt that these constitute the rare exception, not the rule. Seeing how prone patients are to recollect, if not to invent, *some* tangible cause for every illness, it is evident that injury plays little if any part in 99 per cent of the cases.

3. **Foreign Bodies.**—If *Oxyuris* is excepted, a foreign body is not found more frequently than in one case in a thousand. In actinomycotic appendicitis they are common.

4. **Oxyuris.**—*Oxyuris* 'appendicitis' is quite common. I have operated on a dozen cases in the last five years. They present an ordinary picture of febrile appendicitis, vomiting is often prominent, but the tenderness over McBurney's point is apt to be rather vague and indefinite. When the appendix is opened, its mucosa is not reddened, and three or four worms are usually to be seen actively wriggling about.

5. **Concretions.**—These are present in 15 to 20 per cent of cases of appendicitis, and 10 per cent of apparently normal appendices (Ribbert). Other figures are those of Krogius—concretions present in 35 per cent of cases of diffuse peritonitis, 27 per cent of patients operated on in the pre-perforation stage, and 12 per cent interval operations. My own experience would suggest that these figures are rather high.

The concretion is formed *in situ*, from a mixture into which dried fæces, calcareous secretions from the mucosa, and possibly, as Williams suggested, unabsorbed fat residues, all may enter. Probably the presence of a true concretion (not of a nodule of fæces), proves that the mucosa is not normal. Concretions play a very important part in determining an acute attack. There is often a very characteristic history of pain without fever for a day or two, due to appendicular colic, then fever from inflammation of the mucosa distal to the obstruction, owing to lack of drainage, then a day later, or less, sudden cessation of pain from perforation, followed by the signs of localized peritonitis.

6. **Kinks.**—Adhesions or kinks obstructing the appendix often induce an acute attack.

7. **Relation to Chronic Intestinal Stasis.**—This is too large a subject to deal with here. Suffice it to say that there is a relation between this condition and appendicitis. I operated two days ago on a college boy with a first attack of acute appendicitis. The appendix was lying outside the cæcum pointing upwards, and was extensively caught up in its whole length in a Jackson's pericolic membrane, just as in Sir Arbuthnot Lane's pictures. The cæcum was large, mobile, and distended.

8. **Menstruation.**—Occasionally the advent of the monthly period precipitates an acute attack.

9. In the majority of cases, however, no definite cause is discoverable why an attack should come on at a particular time. There is no doubt that the stirring up of peristalsis by the injudicious administrations of a purgative has often converted a mild attack into a severe one by inducing perforation.

SUMMARY.

1. There has been a real increase in the frequency of appendicitis in Great Britain and other civilized countries, especially during the period 1895 to 1905.

2. Neither increased meat-eating nor any other addition to the food-supply seems to account for all the facts. It is suggested that the cause is the relatively less quantity of cellulose eaten on account of the wider use of imported foods.

ADDENDUM.

There are a few uncivilized countries where the diet is peculiar, and the natives live principally on meat. Particular interest attaches to the incidence of appendicitis under these circumstances. Unfortunately the available information is only enough to make one anxious for more.

Paraguay.—The inhabitants are practically in a semi-savage state in the Chaco, away from the towns. They are of mixed Indian and Spanish descent. The diet consists of beef three times a day, a species of potato, probably almost free from cellulose, and maté, which is a sort of tea. They seldom get anything else. I am informed by an unqualified practitioner who has spent ten years in the country that appendicitis is quite common.

Labrador.—Dr. Hutton writes me as follows: "I spent seven years among the Eskimos of Labrador, 1903–8, 1911–13, and was in close touch with the health conditions of the thousand or so of natives who are scattered in villages along the northernmost five or six hundred miles of coast-line. The Eskimos of N. Labrador are flesh-eaters, taking most of their food raw—fresh, frozen, or dried. They also boil their food occasionally. The staple foods are seal, cod-fish, and sea-trout: other occasional foods are deer-meat, walrus, white whale, ptarmigan, hares, bears, foxes, seabirds (and their eggs), rock cod, sculpins, and sea-urchins. Vegetable foods are very scanty, limited to berries (*Empetrum nigrum*) in the autumn, and shoots and buds (*Sedum roseum* and *Salix argyrocarpa*) in the spring. The Eskimos add no salt to their food. With the touch of civilization the use of flour and ship's biscuit has become general, especially on hunting expeditions, and to eke out in times of scarcity; tea is freely taken, sweetened with molasses. The pure Eskimos are teetotalers, and heavy smokers.

Appendicitis must be very rare: I know of no case among the primitive raw-flesh-eating Eskimos. During my seven years I only saw one case in an Eskimo, and that was in a young man whose dietary had been a mixture of native and semi-European foods, such as salt pork, salt fish, bread and biscuit."

Unfortunately a population of only 1000, and that scattered over five hundred miles of coast, is scarcely large enough to furnish much indication as to the frequency of appendicitis as compared with such a community as an English town. In the Bristol district a population of say half a million yields perhaps 500 cases a year, which represents an incidence of 1 case per 1000 head of population annually. A doctor dealing with 1000 potential patients would therefore see 7 cases in seven years. Probably the Eskimos over a five-hundred-mile coastline might not be as ready and able to see a doctor as in an English town. It is difficult, therefore, to estimate the real frequency of appendicitis in Labrador. It is interesting that one case was seen, but evidently it is less common than in such a town as Bristol.

It has been suggested to me that a possible cause of the increased frequency of appendicitis in civilized countries is to be found in the widespread use of cheap Japanese

tooth-brushes, which have flooded the market since 1895 to 1900, and which are very apt to part with their bristles. Once again the theory helps us to understand how many different avenues have to be explored before a settled conclusion can be arrived at. Bristles are, however, so seldom met with in inflamed appendices that the suggestion is not likely to be true.

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SEX AND AGE INCIDENCE IN APPENDICITIS.

By A. ERNEST MAYLARD, Glasgow.

With the object of ascertaining the relative frequency of appendicitis in the two sexes and at the various periods of life, I have taken one thousand consecutive cases admitted to my male and female surgical wards in the Victoria Infirmary. These cases practically cover the last ten years, and therefore extend over a period which may be regarded as fairly representative of our present knowledge of the disease in all its varied aspects.

The accompanying charts (*Fig.* 120) have been constructed to present graphically the respective sex and age of the patients. They embrace all phases of the disease, whether acute, subacute, chronic, or intermittent.

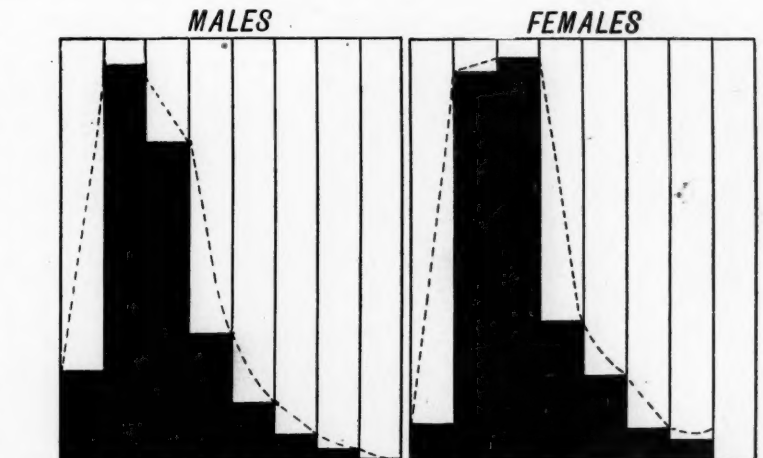

Fig. 120.

It will be noted in the first place, that, so far as the frequency of occurrence in the two sexes is concerned, there is practically no difference; for there were 488 cases in the male, and 512 in the female, a difference of 24 only. In the second place, the ages at which the disease is most frequent also shows a remarkable similarity. For, if the two decades of 10 years to 20, and 20 to 30 are combined, in each instance the total number of males attacked between the ages of 10 and 30 is 330, and of females 363 —an excess of only 33. At all the other periods of life there is very little difference between the two sexes.

As regards the periods of life in which the incidence of the disease is greatest, it will be seen that by far the largest number is in the second and third decades. There is a very sharp rise after the first decade, and an equally rapid decline after the third, to be followed by a more gradual diminution in the succeeding decades.

The youngest patients were four male children, each between 3 and 4 years of age. In each of these there were *B. coli* abscesses. In two, there were stercoliths; in the third, the appendix was gangrenous; in the fourth, there was an ulcer which had perforated.

The oldest patients in the eighth decade were three males two of 73 years, and one of 71. In the former two patients, one was a chronic case in which there had been three previous attacks; the other had a *B. coli* abscess with an appendical stercolith. In the patient of 71 years the appendix was gangrenous. It is of interest, therefore, to note that, from the earliest periods of life to the latest, there is practically no difference in the pathological lesion to be encountered.

TRAUMATIC DISLOCATION OF THE KNEE-JOINT.

By HARRY PLATT, Manchester.

Within the last few years the numerous cases of injuries of the crucial ligaments of the knee-joint sustained under the conditions of military service have afforded a surgical problem which has quite eclipsed in interest and economic importance that of the commoner forms of knee-joint derangement. The instability of the joint characteristic of the crucial ligament rupture is a very serious handicap, judged from the standard of activity expected from a young man, either industrial or athletic. The individual concerned must either contemplate the life-long wearing of an adequate knee brace and often a career of comparative inactivity, or may elect to undergo some form of operative treatment in

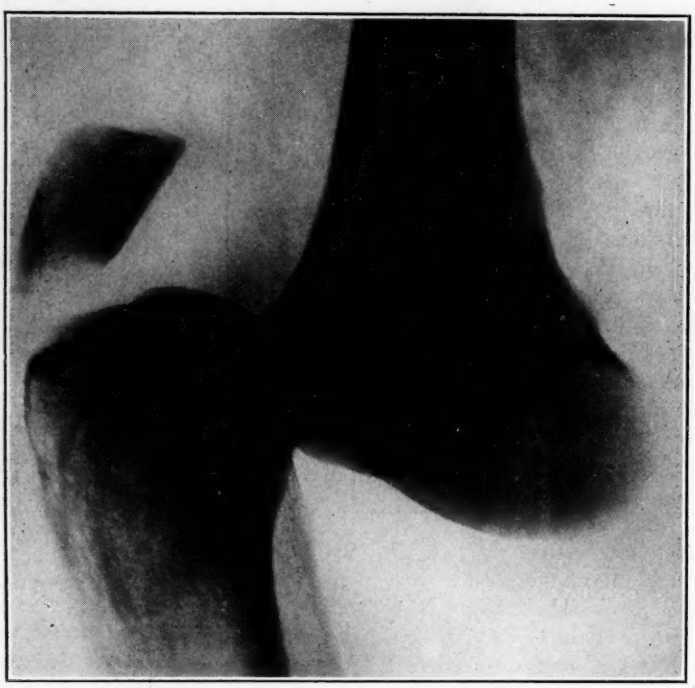

Fig 121.—J. E. Dislocation of the knee-joint.
(*Ancoats Hospital Radiographic Dept., Dr. W. J. S. Bythell.*)

which a reinforcement or replacement of the injured ligament is the essential feature. The ingenious operations of Hey Groves[1] and Alwyn Smith[2] at the present time represent the acme of achievement in dealing with this type of disability. But even to-day it must be admitted that these reconstructive operations are still on trial, and for many reasons can hardly be included in the *répertoire* of the average surgeon. It is, therefore, still essential to emphasize the importance of the prevention, if possible, of those untoward mechanical results which are seen to follow rupture, complete or incomplete, of one or

both crucial ligaments. This implies the early recognition of these lesions, and particularly of the slighter grades of injury which often may be associated with the better-known semilunar cartilage and internal lateral li0gment injuries.

The gravest type of crucial ligament injury is that which accompanies a complete dislocation of the knee-joint. Two examples of this rare dislocation came under my immediate care in 1915 and 1916 respectively. The functional result obtained in the second case has been so striking as to warrant comment.

Description of Case.—In April, 1916, a man, age 47, was admitted to the Ancoats Hospital twenty minutes after sustaining a fall from the top of a ladder. His headlong descent was arrested by a plank close to the foot of the ladder so that the full brunt of his fall was borne by his left knee, the mesial aspect of which encountered the plank with tremendous force. When examined on admission, the clinical signs rendered the diagnosis of complete dislocation of the knee-joint obvious, and a radiogram, taken before reduction was attempted, provided a graphic record of this unusual type of knee-joint injury (*Fig.* 121). It was noteworthy that there was very little effusion in and around the joint, and there was no sign of vascular obstruction in the lower leg. Reduction of the dislocation under anæsthesia presented no difficulties.

After a stay of seven days the man left hospital with the knee immobilized in a plaster cast. He reported from time to time in my out-patient department, and at the end of four months the cast was removed and a Thomas caliper splint substituted. For some little time before removal of the plaster the patient had been walking on the limb with comfort. Seven months from the time of the accident the man returned to work, having worn the caliper splint for six weeks only; after a period on light duties he finally resumed his old employment as a general labourer. When the knee-joint was examined after removal of the plaster, it was found to be quite stable, and showed great restriction of movement, a range of not more than five degrees active and passive flexion being possible. During the following six months the range of mobility showed a gradual increase, so that eleven months from the time of the accident the joint, painless as before, allowed twenty degrees flexion. Beyond this point there appeared to be very firm resistance. The joint stability remained unimpaired, and it was impossible to elicit any sign of crucial-ligament laxity. The patient expressed himself as satisfied with this as a permanent result. It was now considered that a further increase in the range of movement was unlikely to take place, and this opinion was expressed by the writer in a previous communication.[3]

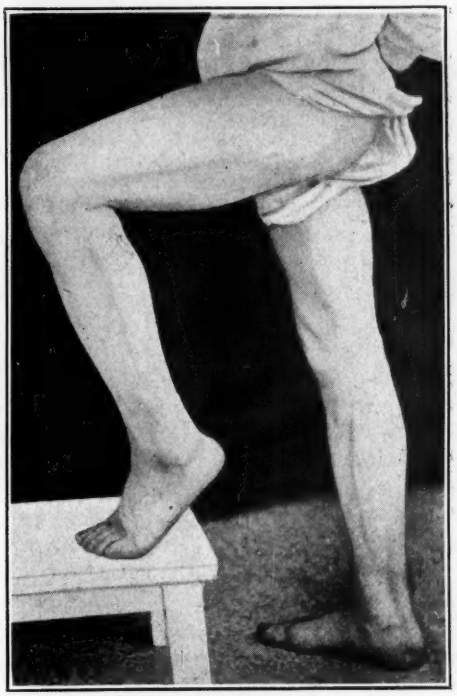

FIG. 122.—J. E. Showing the range of flexion four years after complete dislocation of the knee-joint.

In May, 1920, the patient visited my out-patient department and informed me that he had served for two years in the army, and that, during the whole of this period, his knee had in no way incapacitated him. On demobilization he had returned to his original occupation, and declared himself still capable of performing the heaviest type of labouring work. The knee-joint now (four years after the accident) shows a range of flexion to just beyond the right angle (*Fig.* 122); in other respects the joint is normal; to all tests its stability is perfect.

Results as felicitous as the above have been recorded after knee-joint dislocations by Sir Robert Jones[4], who has emphasized the one essential feature in the after-treatment, viz., the continuation of immobilization for a considerable period. It is obvious that this principle is equally applicable to all grades of crucial-ligament rupture where the dramatic accompaniment of a dislocation is wanting. An inquiry into the histories of patients who present themselves with the typical unstable knees due to crucial-ligament injuries, almost invariably brings to light the striking fact that, immediately following the trauma, a very short period of complete fixation was maintained, and that this was not followed by a period of deliberate restriction of the range of mobility. If it is possible to ensure a stable knee-joint after the occurrence of a dislocation, it should be at least equally easy to obtain stability after less severe injuries of the crucial ligaments. Given an established diagnosis from the outset, it is far better to aim for stability at the expense of mobility. When all the tests demonstrate that sound healing of the ruptured ligaments has taken place, any residual limitation of joint mobility can be dealt with by the usual measures.

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AN INVESTIGATION OF THE CAUSE OF DEATH IN CERTAIN CASES OF EARLY FATALITY SEEN AT A CASUALTY CLEARING STATION.

By Captain H. W. KAYE, R.A.M.C.

These notes give a brief résumé of certain points of pathological importance that have been observed at various autopsies which were made in order to ascertain the cause of death in each case, and so to throw light upon future questions of diagnosis and treatment. The casualty clearing station in France, at which this work was performed, was situated at a distance of less than ten miles from the front. It therefore received casualties with very severe wounds which, in the worst cases, might be fatal within the first twenty-four hours after their infliction. It is for the latter reason especially that the facts recorded in these notes are of interest, because the lesions which prove fatal at this early time present a different appearance from those that have been described elsewhere in pathological observations made on wounds that proved fatal at a later date.

WOUNDS OF THE CHEST ONLY.

The cases examined were 14 in number, 3 having been caused by high-velocity bullets, and the remaining 11 either by shell-fragments or shrapnel.

The cases fall into two main groups, namely :—

1. Ten who died within twenty-four hours after the wound from the immediate effects of the injury.

2. Four who survived this stage, but succumbed to later septic complications on the fifth, ninth, and twelfth days.

A hæmothorax was found in each of the 14 cases, and in no one of those who died in the first twenty-four hours was there evidence of the presence of air together with the blood in the pleural cavity. The blood in these early cases (*Group* 1) was fluid, and practically free from clot. Its quantity varied greatly; but the lower measurements are of little value, because they were often spoiled by the free leakage of fluid through the external wound in the chest. The maximum volume found on one side was 4¾ pints; from 1 to 2 pints was found in several cases.

The lung was found to be wounded in 12 out of the entire 14 cases; but the type of this wound varied in proportion as the chest wall was more or less lacerated by the entering missile. When the entry wound in the chest wall was a tiny track through an intercostal space, a similar track through the lung substance would be found; but even in these simplest of wounds, the lung around this narrow lumen was found to have been infiltrated with clotted blood over an area of about one inch in diameter. With severer wounds that had caused comminuted fractures of the ribs, the subjacent lung was found to present an irregular lacerated wound, often containing splintered portions of rib, clothing, and dirt, while the whole of the wounded lobe was infiltrated with extravasated blood, and looked and felt firm and solid.

There were 3 cases of bilateral hæmothorax, and in each of these the missile (in 1 case a bullet and in the 2 other cases a piece of shell) had passed through the bodies of the 7th, 8th, or 9th thoracic vertebræ without causing any injury to the spinal canal, and without producing any clinical phenomena indicative of damage to the cord.

Septic Hæmothorax.—The outstanding feature of all the four cases in *Group* 2 was the large size of the empyema cavity, which was practically coterminous with that of the pleural

sac. The infection was apparently free to spread in every direction, as it was not limited by earlier adhesions, but only by the reflexions of the pleura. Thus a very large abscess cavity and surface for absorption is formed, which is doubtless the factor which makes the prognosis in this condition serious, although the absence of earlier adhesions must facilitate the establishment of free drainage surgically. The case of a man who died on the fifth day from infection of a hæmothorax with gas-forming organisms is worth quoting in detail.

Case 1.—The patient was admitted with a shell wound of the left side of the chest, and in extremely bad condition—much collapsed and very dyspnœic: pulse-rate 140, respirations 56, and temperature 102°. After two days he had improved slightly. On the fourth day some of the hæmothorax blood was drawn off in the hope of giving relief. This blood was offensive, and was found to contain a large Gram-positive bacillus which was identified with *B. perfringens*. The patient was so ill that it was impossible to attempt surgical drainage of the pleural cavity, and he died the following day. At the autopsy, gas under pressure was found in the left pleural cavity, and the lung was completely collapsed against the vertebral column, being reduced to an airless mass about the size of a fist. The pleura contained two and a half pints of brownish-tinged, most offensive blood, in which there were a few flocculi but no clots. The surfaces of the lung and parietal pleura were covered with soft shreddy fibrin, enmeshing bubbles of gas which gave it the general appearance of a mass of frog's spawn. A fragment of shell covered with khaki cloth was found with some spicules of bone in the upper lobe of the atelectatic lung, which it had entered through the third and fourth ribs posteriorly.

WOUNDS OF CHEST AND ABDOMEN COMBINED.

The cases examined were 22 in number, 6 having been caused by bullets, and 16 by shell and bomb fragments. A hæmothorax resulted in 20 out of the 22 cases. The remaining 2 showed a plastic pleurisy at the base of the lung, but no evidence of a hæmothorax. In each of these last two cases the missile had entered the left side of the chest low down posteriorly, and had perforated the lowest part of the pleural cavity in the immediate neighbourhood of the costodiaphragmatic reflection of the pleura, so that they could hardly be regarded as chest wounds.

In only 6 out of the 20 hæmothorax cases could wounds of the lung be found, and in three of the six the thin free margin of a lobe had been only just touched by the missile. Of the 14 in which the lung was not wounded, 4 presented a small localized bruise, while in the remainder no abnormality could be found beyond a varying degree of collapse.

The hæmothorax in this series of cases must therefore have been derived either from bleeding viscera in the abdomen, or from injured vessels in the chest wall. If it came from the abdomen, a natural assumption would be that such a hæmothorax would be more frequent on the side of the liver. Yet in this group of 20 cases the collection of blood occurred on the left side in 11, and on the right in only 6 examples, while it was bilateral in the remaining 3.

The frequency of the occurrence of a traumatic hæmothorax without any wound of the lung in this last group of abdominal cases therefore suggests strongly that in the majority of examples it is the chest wall which is the source of bleeding. It should be noted that even in the cases in which the lung had been wounded, the extravasated blood within and around the wound was seen to form a firmly-clotted mass within twenty-four hours of the infliction of the wound, so that it is at any rate improbable that prolonged hæmorrhage can continue from this source. On the other hand it was observed that, taking all the 36 cases together, namely those with wounds of the chest only and those of chest and abdomen combined, the missile in entering the chest had caused no fracture of the ribs in 11 cases. A fracture of one or more ribs was seen in 25 cases. It is, however, difficult to draw a clear conclusion from these latter figures, because rib fracture was generally associated with laceration of the lung, and each of the two possible sources of hæmorrhage was therefore fully developed.

For purposes of description the 22 cases in the group of combined abdominal and chest wounds may be divided as follows:—

1. Fourteen who died from the initial lesion (9 within twenty-four hours, and 5 within three days).

2. Six who underwent operation for abdominal injury.

3. Two who died from the rapid development of septic complications.

1. Of the 14 cases, 8 presented a wound of the kidney, 8 of the liver, 6 of the spleen, 1 of the stomach, 1 of the transverse colon, and 5 of the bodies of the dorsal or lumbar vertebræ without injury to the spinal canal. The wounds of these organs occurred in various combinations, the most frequent being a wound of the liver together with a wound of a kidney or the spleen. Some degree of retroperitoneal or intraperitoneal hæmorrhage was found in most of them, but in no case was there a large amount of blood extravasated below the diaphragm. The cause of death appeared in general to be that of shock together with combined hæmorrhage into the thorax and abdomen.

2. A case may be quoted under this heading to show how extensive these combined injuries may be, and how hopeless is the nature of the work that may confront a surgeon when he attempts to save life by operation on a man whose outward appearance may not suggest that his condition is in any way more desperate than that of others in whom the surgical repair of internal wounds has been performed with brilliantly successful results.

Case 2.—Laparotomy was performed, a wound on the anterior surface of the pylorus and three lacerations in the jejunum being discovered. The bullet was lying loose in the lumen of the bowel. The wounds were rapidly sutured, but the patient died four hours later.

It was then found that the bullet had perforated the upper lobe of the left lung, and passed in and out of the posterior wall of the pericardium, where it had made a wound ¾ in. long in the left auriculoventricular wall of the heart and half-way through its thickness, so that in addition to a hæmothorax there was distention of the pericardium with blood and air, which entered freely from the pleural cavity. The bullet had then passed on to the abdomen and had caused, in addition to the wounds revealed by operation, an in-and-out wound of the right half of the extra-peritoneal surface of the transverse colon, and a perforating wound of the posterior aspect of the pylorus.

3. One of these cases was a striking illustration of the rapidity with which an infection by gas-forming organisms may spread and cause death.

Case 3.—Admitted three hours after he had received a shell wound of the right arm and chest. His condition was then good, with a pulse-rate of 110, and this state continued for the first twelve hours after infliction of the wound. An hour later he had passed rapidly into a condition of extreme danger, being pale, sweating, and without radial pulse. He died just within twenty-four hours of the wound, with much swelling and discoloration of the chest wall, neck, head, and scrotum.

It was then found that a small shell fragment had passed through the muscles of the right arm, where the wound was perfectly clean, and entered the right side of the chest through the 9th space in the posterior axillary line. A hæmothorax was present, though the lung was not wounded. The missile had then passed through the diaphragm, right lobe of the liver, and upper pole of the right kidney, and had buried itself in the lumbar muscles. The liver (examined two hours after death) was so distended with bubbles of gas that it floated in water. Gas bubbles were also found in the substance of the spleen and throughout the right kidney. The discoloured subcutaneous tissues and a large retroperitoneal hæmorrhage in the right loin were all crackling and full of gas.

PLEURAL ADHESIONS.

A somewhat surprising fact was noticed in regard to the frequency with which old pleural adhesions were found at autopsies upon all subjects. The majority of these examinations were made for wounds received in battle or for acute disease in men who previously had not been in any way disabled for active service. Yet, in a series of 104 consecutive autopsies, old pleural adhesions were found in 34 of the cases. These adhesions varied widely in degree and distribution, from a few bands at one apex to dense universal bilateral adhesions binding both lungs firmly to the chest wall. In only a small minority could evidence of healed tuberculous foci be found in the lungs or elsewhere.

Soldiers upon active service, and especially those who are working in the fighting area, are presumably the healthiest possible collection of individuals, and it is surprising that 30 *per cent of them should present evidence of past pleurisy.*

WOUNDS OF THE ABDOMEN ALONE.

During the period dealt with in these notes there are records of 32 autopsies upon penetrating or perforating wounds of the abdomen; for purposes of description and comparison these cases are divided into two main groups, viz. :—

1. Thirteen men who were not subjected to operation.
2. Nineteen who underwent laparotomy.

1. These cases lived long enough to be brought down to the casualty clearing stations, where they arrived for the most part within a few hours of being hit. They all died within twenty-four hours of being wounded, except one who died within thirty-six hours. It may be said of them that their general condition was so bad, and showed so little improvement with rest and warmth in bed and other restorative measures, that it proved impracticable to subject them to an abdominal operation. They died of a combination of shock and hæmorrhage, and it is difficult to apportion the share which each of these factors took in causing death.

As will be seen later, many of those who rallied sufficiently to undergo laparotomy and succumbed later to various complications, presented lesions apparently of the same nature and extent as those for whom it proved impossible to attempt any operative relief; this is also true of the numerous cases in which the operation was successful and the patient recovered.

In the group under consideration there were 9 bullet wounds (4 penetrating and 5 perforating) and 4 shell wounds (all penetrating). The wounds of the abdominal wall were usually quite small: the entry wound about the size of the cross-section of a lead pencil in most cases, and the exit in perforating wounds being generally somewhat—but not much—larger than that of entry. Protrusion of abdominal contents through the wound is exceptional in patients brought back as far as a casualty clearing station; when it occurred, omentum or a coil of gut was usually found, the protruding portion itself often presenting no injury.

The following notes are quoted as exemplifying an average case of this group.

Case 4.—Pte. S. was admitted for bullet wound of the abdomen; he had been hit four hours previously, and on admission was much collapsed, cold, and had a feeble rapid pulse. He was at once put to bed, and the usual restorative measures were applied; these, however, failed to improve his condition enough to make laparotomy possible, and he died within twenty-four hours of being wounded.

At autopsy he presented a small entry wound over the upper part of the left sacro-iliac synchrondrosis and a slightly larger exit wound midway between the umbilicus and right anterior superior iliac spine. On opening the abdomen, the parietal peritoneum showed a slit 1½ cm. long over the left side of the brim of the pelvis corresponding to the entry wound, and a similar slit, ½ cm. long, corresponding to the exit wound.

The peritoneal cavity was 'full of blood'—four pints measured. The greater part of this was fluid, containing some dark-red clot; this appeared to have come chiefly from vessels in the left side of the pelvis and the mesenteric vessels.

The small intestine presented in its lower two-thirds four lacerated perforations, separated from each other by lengths of a foot or more of uninjured gut. Two of these perforations were irregular lacerations involving half the circumference of the tube, and through these the cut edges of the mucous membrane pouted, filling up the tear in the remaining coats; at the other two 'perforations' two or three inches of the whole circumference of the gut had been blown out of continuity. There were two tears about an inch and a half long in the mesentery from which bleeding had taken place, and also two characteristic slits involving only one layer of the peritoneum forming the mesentery. There was no other injury of any viscus.

Of the 13 cases in this group, 8 had lacerations of the small intestine (7 of the ileum and 8 of the jejunum, multiple in each case), 5 of the large intestine—single in each case except one—1 of the stomach, 2 of the liver, 1 of the bladder; 2 had a perforation of the inferior vena cava, 1 of the right external iliac vein. These lesions occurred in various combinations.

Rents and slits in the mesentery, and hæmorrhage into it, were frequently found, and these must have an important effect upon the power of recovery of the corresponding

portion of the intestine. Extensive and well-marked gas gangrene of the abdominal wall and of a large retroperitoneal hæmatoma was found in two of these cases, another instance of the extreme rapidity with which this formidable complication may develop.

Hæmorrhage, both retroperitoneal and intraperitoneal, was a feature common to every one of these wounds. The blood behind the peritoneum frequently presented a large mass of solid clot several inches thick, while that within the peritoneal cavity was fluid, with numerous clots floating in it. In most cases the abdomen was what is usually described as 'full of blood'; measurements, which were difficult to carry out with accuracy, showing that this means as a rule the presence of from 2 to 4 pints of blood.

From this description it will be seen that, broadly speaking, there are three conditions in respect of coagulation in which the effused blood may be found. First, there is the massive clot of the retroperitoneal collection; secondly, the fluid blood with much mushy clot floating in it, which occurs in the peritoneal cavity; and, lastly, the blood in the pleural cavity, which is almost entirely fluid and with only a few visible clots. The difference in these conditions finds a natural explanation in the view that has been put forward by Elliott and Henry[1] to account for what is found in a hæmothorax, for they have argued that the effused blood rapidly undergoes the process of coagulation in all cases of wound, but that where there is much mechanical movement of the blood, as by the respiratory action in the chest, this coagulation is interfered with, and the fibrin is partly 'whipped out', leaving a fluid blood behind.

Wounds of the small intestine were the most frequent lesion in both *Groups* 1 and 2, and they were usually multiple. There was seldom any visible leakage of intestinal contents, even when a portion of the tube had been blown completely out of continuity. Where the intestine was perforated, a lacerated wound, varying in size from a small puncture to a tear involving half the circumference of the bowel, was produced, and the everted edge of the torn mucous membrane pouted into the wound and plugged it. When the gut was completely divided or a portion blown away out of continuity, the severed ends above and below were found to be collapsed and flaccid.

The multiplicity of the wounds is often difficult to understand. Five or six perforations are often found in a few inches of the gut, while in other cases similar wounds may be separated by several feet of uninjured gut. In one case there were no less than ten distinct lacerations in the last few feet of the ileum. These observations suggest that some of these lacerations may be caused by bursting, the intestinal wall having given way as a result of the splash of the blow rather than of having been directly injured by the missile. But no special feature in the lacerations themselves was noticed to lend colour to this suggestion.

Wounds of the large intestine were less frequent, and less often multiple. Leakage of contents was the rule, even with small lacerations; and, with a large tear, fæces have been found freely scattered about the peritoneal cavity.

2. Laparotomy had been performed on 19 cases. These operations were all performed within eight hours of the receipt of the wound, and some of them after an even shorter lapse of time.

Death occurred at various intervals thereafter, namely:—

Within forty-eight hours of wound—6 cases—
5 from hæmorrhage and shock, 1 from gas gangrene.

On the fifth, sixth, and seventh day—6 cases—
4 from ileus, 1 from general peritonitis, and 1 from general peritonitis and bronchopneumonia.

On the eighth, ninth, and eleventh days—3 cases—
From general peritonitis and bronchopneumonia.

On the twelfth day—3 cases—
1 from ileus, 1 from general peritonitis, and 1 from bronchopneumonia.

The remaining case died after a month of general septic infection.

Of the fatal complications, ileus and bronchopneumonia are deserving of remark.

Ileus caused the death of 5 patients who died from the fifth day onwards. It would seem that this condition is attributable in some way to injury to the intestine, its vessels or nerves, and not to septic infection. It was found in various forms, most frequently following resection of the small gut and anastomosis, in which case the distention affected the segment of gut (6 to 12 inches in length) immediately above the line of union, at which point it ceased abruptly. In a case of double resection, this had happened at the upper anastomosis, while the gut on either side of the lower anastomosis showed no signs of paralytic distention. The unions by suture had held soundly in this, as in all the other cases examined.

That the condition is not invariably due to local traumatism to a limited portion of the intestine was shown by a case in which the only wound of the intestine was a single laceration of the splenic flexure which was successfully converted into a colostomy. The patient died on the eighth day, and at autopsy the small intestine was found to be distended. This distention affected the whole ileum, being greatest at the upper end, where the gut was quite six times the calibre of the lower end. The transition was perfectly gradual throughout as the gut was traced downwards to its normal dimensions a few inches above the ileocæcal valve, there being no sudden alteration in calibre anywhere. No injury to the abdominal viscera other than the laceration of the splenic flexure found at operation was discovered, nor was there any peritonitis except the local changes around the colostomy.

Bronchopneumonia was of a definite and uniform type. It was confined to the lower lobes of the lungs, though these do not appear to be simultaneously affected, for the condition was generally found to be more advanced on one side than on the other. In its typical form the whole lobe was almost solid, deeply congested and œdematous, and containing very little air ; portions sank rapidly in water. Areas of solidified lung substance, varying in size from a small marble to a walnut, could be seen and felt, giving the lobe a knobby appearance and feel. On section, these nodules showed a central bead of pus, which exuded from the bronchiole on pressure, and around this was an area of solidification, deep purple or whitish in colour according to the length of time the condition had existed. The tubes throughout the affected lobe showed intense inflammatory changes with abundant secretion. It may be observed that this condition appeared also to be common, clinically, in cases which recovered after laparotomy for abdominal wounds. Probably the initial condition following upon the abdominal lesion was that state of massive collapse which Colonel W. Pasteur was the first to describe.[2] Following upon this collapse, a bronchial infection may have developed into a bronchopneumonia in the fatal cases.

MISCELLANEOUS CASES.

Case 5.—**Meningococcus septicæmia. Death in twenty-four hours.**

Pte. A. E. W. Marched eleven miles with his battalion on April 4, 1916, and did not feel ill enough to report sick till midday on April 5. When first seen a few hours later, he was obviously extremely ill—temperature 101·6° ; pulse 144, small and irregular ; respirations 44 ; tongue brown and furred. On examining his legs (in which he complained of great pain) the hæmorrhages described below were seen all over the lower limbs and buttocks, and fewer scattered about the arms. These bluish-black blotches, many of them the size of a penny but of irregular shape and varying size, scattered thickly all over the lower limbs, presented a most striking appearance, and at once showed that we were face to face with some very unusual condition. His ankles and feet were exceedingly tender : knee-jerks were brisk and equal, plantar reflexes flexor in type ; Kernig's sign was not obtained, nor was there any stiffness or pain in the neck muscles. He complained of slight headache, but apart from this no symptoms or sign of cerebrospinal irritation could be elicited. The heart was normal in size and position, and the only abnormal physical signs in the lungs were those suggesting early pneumonia, or a thin layer of fluid with some collapse of the left lower lobe. His condition showed no material change during the remaining few hours of his life, and at 2.15 a.m. on April 6 he died, *well within twenty-four hours of the time at which he first felt ill enough to report sick.*

An autopsy on the same day showed : The lower limbs and buttocks present numerous pale blue-black blotches, which are of various sizes and irregular shapes, varying from a pin's head to 3 cm. in diameter. They are present on both surfaces of the lower limbs, being more numerous and larger towards the lower part, and especially upon the feet. A few are scattered

on the arms and forearms, where they are for the most part smaller; there are none upon the hands, trunk, face, or neck. On section they are seen to be hæmorrhages into the deeper layers of the skin, and not raised above the general surface of the skin.

The left pleural cavity contains 10 to 15 oz. of brownish-yellow clear fluid, the right pleural cavity the same quantity of blood-stained fluid; the parietal pleura shows universal injection, the visceral pleura a few tiny scattered hæmorrhages. Both lungs are firm; the cut surface is firm to the touch, and exudes much frothy fluid on squeezing; portions float in water. The spleen is large, soft, and friable. The kidneys are unusually large, pale, and firm; on section the substance bulges and curls up over the cut edge of the capsule, and that of the cortex is covered with glistening slightly-raised points and streaks. The liver presents a similar appearance.

Brain and Cord.—The cortical veins are distended with dark fluid blood; this congestion is specially evident all over the vertex, and gradually diminishes over the lateral aspects of the cerebrum till it disappears at the margin of the cisterna magna. There is no flattening of the cerebrum. No excess of fluid in the ventricles, no hæmorrhages, stickiness, or lymph to be found anywhere. The cord appears perfectly normal, both externally and upon section at various levels. In short, with the exception of the above vascular condition, the brain and cord are quite devoid of any naked-eye abnormal appearances. No other abnormal condition was found in the other organs.

Captain A. W. M. Ellis, C.A.M.S. (No. 5 Mobile Laboratory), examined the blood and cerebrospinal fluid before death at 10 p.m. on April 5, and reported: The blood was inoculated into plain broth, which showed a fairly profuse growth of a Gram-negative diplococcus in eighteen hours. Prolonged search of film preparations from the blood failed to show any micro-organisms. A blood-count was not made, but the appearance of the films suggested the existence of a leucocytosis; a differential count of 500 cells showed a considerable relative increase of large mononuclear cells.

Cerebrospinal Fluid.—From lumbar puncture: Fluid absolutely clear, limpid, no clot on standing, no sediment on centrifugalization. Cell-count, 12 per cm., of which 11 were polynuclear leucocytes. The fluid was centrifuged and then poured off, after which the tube was inverted and allowed to drain. The small amount of fluid remaining adherent to the tube was then picked up with a fine capillary pipette, and smeared on a glass slide. This sediment when stained showed a few cells, chiefly polynuclear leucocytes, and large numbers of diplococci, morphologically meningococci. They were practically all extracellular, and were so numerous that 50 to 90 pairs were frequently present in one microscopic field.

Culture and inoculation showed the organisms isolated from the blood and cerebrospinal fluid to be identical, and to be Type I meningococci.

Staphylococcus Aureus Pyæmia.—In civil life it is by no means a rare event to meet with a case in which a local infection by staphylococci, e.g., in a boil, has gradually infected the circulation and led to the development of scattered pyæmic abscesses, particularly in the kidneys, which ultimately prove fatal in the course of an illness of many weeks' duration. The two cases described below illustrate an overwhelmingly rapid development of what is essentially a similar condition. Staphylococcal infections at the front as a rule are benign and local. Occasionally blood septicæmias from staphylococci, mixed with streptococci, have been met with, which caused prolonged fever mimicking enteric, but ultimately cleared up without leaving any local focus of suppuration. The fulminating pyæmia described here is uncommon, but it has occurred also in the experience of other medical officers in France.

Case 6.—Sergt. C. was admitted with a suppurative condition of his upper lip, which had originated in an abrasion a week previously. He was anæsthetized and the lip freely incised, with apparent benefit to the local condition. The following day, however, he developed symptoms and signs of acute pulmonary disease with profound toxæmia. *Staphylococcus aureus* was grown from the lesion in the lip and also from the circulating blood. He died on the third day after admission. At autopsy it was seen that the incised suppurating area lay chiefly to the right of the mid-line of the upper lip, with some swelling of the adjacent skin. Incisions showed in the subcutaneous facial tissue numerous tracks containing dirty-yellow pus; they were distinct from each other, and extended up under the nose and almost to the lower margin of the right orbit, back almost to the right ear, just over the inferior margin of the right horizontal ramus of the mandible, and upon the left side of the face an inch out from the left angle of the mouth. The lower lip appeared normal.

The pleuræ were intensely inflamed throughout, with some recent (as well as old) adhesions; there was about an ounce of yellowish fluid in the right pleural cavity.

The lungs were œdematous and studded throughout with abscesses; many of these were so small as to be only just visible; the largest were as big as a small cherry; and between these extremes they were of all sizes. They were more numerous in the upper lobe. The lower lobes showed a good deal of collapse. There was general bronchitis and bronchiolitis. The remaining

viscera, including the heart and pericardium, showed no macroscopic departure from normal. The brain appeared healthy, except that on the vertex there was evident lymph along the main vessels in the sulci.

The second case, which was admitted within three days of the other, presented very similar features.

Case 7.—Spr. S. was admitted for 'pneumonia'. Although he was evidently suffering from acute pulmonary disease, the case did not appear to be quite straightforward. It was noticed that he had a boil upon the left shoulder; this had been incised, and was, in the patient's opinion, getting better, but during his first three days in hospital it took on a more active appearance, while the surrounding skin became tense and inflamed. Free incisions were made into this area, and *Staphylococcus aureus* was grown from the pus so obtained, and also from the circulating blood. The patient died on the fifth day after admission. The ultimate findings were, in essential, almost identical with those in the foregoing case. Incisions showed pus tracks running from the boil on the shoulder for a radius of 4 in. throughout the surrounding subcutaneous tissues. The condition within the thorax was almost exactly the same: intense bilateral universal pleurisy; lungs studded throughout with abscesses of the same size and distribution; heart and pericardium normal. The only different feature was a circumscribed abscess in the cellular tissue beneath the sternum. The only abnormality found in the brain was evident congestion of the vessels of the vertex.

These two cases were remarkably similar, and it is curious that they should have occurred within a few days of each other. Clinically they differed in that the first case did not show signs and symptoms of acute pulmonary disease until thirty-six hours before death, whereas the second presented them unmistakably for six and probably seven days; at autopsy the lungs of the two cases presented an almost identical appearance, and one could not but believe that the condition had existed for approximately the same length of time in both.

Case 8.—**Thrombosis of internal carotid artery, following contusion by shell fragment. Hemiplegia. Death.**

Pte. L., admitted for shell wound of neck; he presented a wound the size of a sixpence just beneath the right angle of his jaw; on the second day he developed left hemiplegia, and died the following day.

At autopsy it was found that a quadrilateral piece of metal, roughly 1 cm. × 1 cm. × ½ cm., had entered as above, and passed to the opposite side of the neck; it had penetrated the side wall of the pharynx just above and behind the right tonsil, and on the left side was lying upon the fractured upper portion of the ascending ramus of the lower jaw.

On examining the vessels in the right side of the neck, a small piece of metal was found impacted in the outer layers of the wall of the external carotid artery; this had not injured the intima, and the interior of the vessel was normal. Half an inch above the bifurcation of the common carotid artery the lumen of the internal carotid was completely filled with ante-mortem thrombus; this extended in direct continuity through the remainder of this vessel and into the right middle cerebral artery and all its main branches, which were thrombosed for a distance of 3 in. from their origin. Neither anterior nor posterior communicating arteries were thrombosed. There was no fracture of the skull.

The surface veins of the brain—both in sulci and on convolutions—were unusually full of blood. The brain substance corresponding to the area of distribution of the thrombosed arteries was soft and diffluent; this condition was most evident in the region of the island of Reil; upon section it appeared to be limited to an area 3 in. × 2 in in size; but little evidence of softening could be found on examining the external surface of the cerebrum. The only other pathological condition found was a moderate degree of œdema of the lower lobes of both lungs.

There can be little doubt that the thrombosis in this case was due to a blow upon the artery by the metal fragment in its progress through the neck, though no naked-eye evidence of injury to the arterial wall could be found. It would seem probable that in such cases the blow must cause a tear or split in the intima, and that this tear provides the starting-point of the thrombosis.

A series of clinical cases of a similar nature, but without autopsy findings, has recently been published by Surgeon-General Sir George Makins.[3]

Case 9.—**Infection of atheromatous carotid artery. Embolism. Hemiplegia. Death.**

Pte. E. F., age 32, was admitted with a shell wound of the soft parts of his right arm; this was freely opened up and drained, and twenty-four hours later he suddenly developed complete left hemiplegia and hyperpyrexia, in which condition he died fifty-four hours after

admission. Clinically this was attributed to a cerebral hæmorrhage, but at autopsy no naked-eye abnormality could be discovered in the brain. However, in the right internal carotid in the interpeduncular space there was some pink fibrinous clot, which could not be traced beyond the origin of the right middle cerebral artery. The right carotid arteries in the neck were then examined, and at the origin of the right internal carotid was found a nodular mass in the wall of the artery, narrowing its lumen so as almost to obliterate it. Within this narrowed lumen was a small patch of pinkish endarteritis, with a small tag of fibrinous clot attached. Sections showed severe medial degeneration, partly calcareous, and a ring of very severe fatty and calcareous atheroma in the common carotid immediately beneath the bifurcation, very slight intimal hypertrophy of the proximal portion of the internal carotid, and a mixed thrombus containing masses of Gram-negative coliform bacilli on the atheromatous bifurcation and the non-atheromatous common carotid. There were similar bacilli on the surface of the intima and in clefts in the atheromatous intima, extending in one spot as far as the media. Similar bacilli were also present on the surface, and in the outer layer, of the adventitia.

The distribution of the bacilli was doubtless a post-mortem phenomenon to a large extent; but there can be little doubt that infection by bacilli derived from the wound in the arm caused a thrombus to form upon the atheromatous area at the bifurcation of the right common carotid; a portion of this thrombus then broke off and blocked the right middle cerebral artery, causing hemiplegia. The rapidity with which death followed the onset of hemiplegia (thirty hours) probably furnishes an adequate explanation of why no naked-eye changes could be observed in the brain substance, for anæmic softening may be difficult to detect even after an interval of two or three days.

REFERENCES.

[1] Elliott and Henry, *Brit. Jour. Surg.*, 1915, iii, 250.
[2] W. Pasteur, *Ibid.*, 1914, i, 587.
[3] Sir George H. Makins, *Lancet*, 1916, ii, 543.

THE PATHOLOGY OF GUNSHOT WOUNDS OF THE SPINAL CORD:

AS ILLUSTRATED BY THE SPECIMENS IN THE WAR OFFICE COLLECTION.

By Sir WILLIAM THORBURN, Manchester.

The War Office Collection of injuries of the spine and spinal cord now lodged in the Royal College of Surgeons is extensive, and contains specimens of almost every type and result of gunshot wound. In a previous communication[1] the writer has, with George Richardson, illustrated many of the osseous lesions from personal specimens, now lodged in the museum, and Keith and Hall[2] have also described others of the dry preparations. It is now proposed to give some account of the wet specimens, of which there are altogether nearly a hundred. These specimens have been dissected and mounted by Mr. Cecil Beadles, and each is accompanied by a description by Professor Shattock. The drawings which illustrate this paper have been made for me by Mr. S. A. Sewell.

In considering the material at our disposal it will be convenient to classify the wounds met with under certain obvious headings. A missile may lodge in the spinal cord or meninges, may pass directly through these structures, or may merely run in more or less close proximity to the contents of the spinal canal. Again it may, either with or without puncturing the canal, impel fragments of bone or of clothing into the interior, thus producing results closely similar to those of its own impact. In all these cases we find a primary injury of the cord, of its nerve roots, or of the meninges, and as a result of such primary mechanical injury we may meet with secondary infection or other local lesions, and with more distant and remote effects, such as those found in the bladder, kidneys, and lungs.

I. CASES IN WHICH A FOREIGN BODY OR FRAGMENTS OF BONE OR CLOTHING ARE LODGED WITHIN THE SPINAL CANAL.

Case 1 is illustrative of many of the conditions produced by a 'lodging wound' of the cord and meninges. A fragment of high-explosive shell was embedded in the back at the level of the 6th dorsal vertebra, and slightly to the left of the middle line. 'Flaccid paralysis' ensued at once. On the fifth day there was paralysis of both lower limbs: anæsthesia to a line about two inches above the umbilicus on the right side and to a slightly lower level on the left; the bladder was paralyzed; plantar reflexes were of flexor type; no knee-jerks, ankle-clonus, abdominal or cremasteric reflexes. Twenty-four hours later there was found a small 'patch of sensation' on the arch of the right foot and some urethral sensation on catheterization. On the eighth day the patient had definite girdle-pain at the level of the 7th ribs, especially on the left side, and the whole urethra presented some sensation. A skiagram showed two metal fragments, of which one appeared to lie inside the spinal canal. One day later the dorsal wound was excised under local anæsthesia. "The left lamina of the 6th dorsal arch was found fractured and depressed, several pieces of bone evidently pressing on the dura mater; two pieces of shell casing were removed, one somewhat superficial to the fractured lamina, the other actually sticking in the dura mater". On removal of the latter fragment, cerebrospinal fluid flowed into the wound, and there was fully exposed a hole in the theca "about the size of an almond"; "the cord immediately in front of the opening was injured a little, white matter being adherent to the deeper of the metal fragments and to one or two of the bony fragments". The wound was drained.

After operation there was a good deal of collapse and vomiting, but the girdle-pain was diminished; there was some cramping pain in the left lower limb. There followed much headache and increasing retraction of the neck. Lumbar puncture removed turbid blood-stained fluid sterile on culture. Nine days later the patient died with symptoms of severe cystitis, and with a continuation of the headache, retraction of the neck, some divergent strabismus, a tendency to opisthotonos, and marked Cheyne-Stokes respiration.

FIG. 123.—Fragment of metal impacted in cord; tear in theca, hæmorrhage and septic meningitis.

At the autopsy, on exposure of the spinal theca it was "seen to be bulging particularly towards the head"; the meninges were bound down to the spinal cord at the seat of operation. There was intense hæmorrhagic cystitis.

The specimen (*Fig.* 123, W.O. 391*) shows the changes met with eighteen days after a lodging wound in the mid-dorsal region. The large aperture to the left of the theca is well seen. A minute fragment of metal still remains within the spinal cord. The latter has undergone much local degeneration, but is not completely divided. The theca is deeply blood-stained, and beneath the arachnoid is a purulent and blood-stained exudation more marked below the wound. The bulging of the upper part of the theca observed at post-mortem examination, and the clinical symptoms, alike point to a meningitis much more widely spread than is seen in the local focus. The presence of girdle-pain before operation and the incomplete anæsthesia are alike explained.

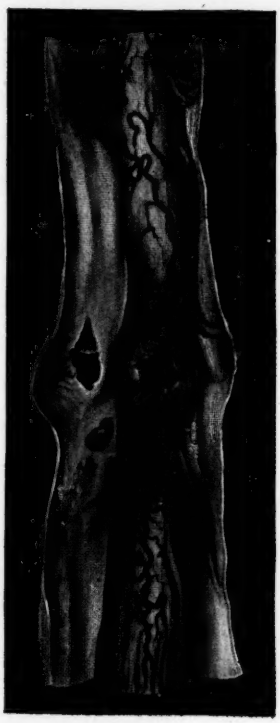

FIG. 124.—Fragment of metal impacted in cord; tear in theca, localized meningitis.

(This case is much more fully reported than are most of the war specimens. The medical officer was Lieut. Bligh, the operation was performed by Colonel Sir Henry Gray, and the autopsy was by Captain W. S. Lazarus-Barlow, No. 9 General Hospital, France.)

Case 2.—With the above may be compared the very similar injury in specimen W.O. 2206. The wound was at the level of the 9th dorsal vertebra about an inch to the left of the middle line; motor and sensory paralysis were complete below the umbilicus; the bladder was distended, and was catheterized twice on the first day, after which urine was allowed to overflow for several days. On the seventh day a rigor was followed by a rise of temperature to 103°; there were 'evidences of cystitis', and the bladder was irrigated with boracic lotion. Rigors and fever continued, death occurring on the twelfth day.

The specimen (*Fig.* 124) shows a small hole in the theca and a fragment of shell-casing deeply embedded in the

* The letters W.O. followed by a number refer to the War Office number quoted in the College of Surgeons Museum.

spinal cord, which was lightly adherent to the dura. There is here far less local inflammation than in *Case* 1. The dura presents no hæmorrhage, nor is there any marked effusion beneath the arachnoid. The cord presents local crushing with some slight effusion of blood, necrosis around the wound, and turgidity of its vessels. At the post-mortem examination a little early bronchopneumonia of both bases was found. The bladder was much distended, its walls were thick and inflamed, and there was plastic peritonitis in the pelvis, with a small amount of turbid fluid among intestinal coils higher in the abdomen. Both kidneys presented hæmorrhagic pyelitis (*Fig.* 125, W.O. 2206 B), shown in the annexed drawing, to which we shall again refer.

FIG. 125.—Kidney from same case as *Fig.* 124; hæmorrhagic pyelitis.

These two cases may be taken, then, as representing a closely similar injury, leading in the one to severe meningitis, and in the other to death from the secondary results of vesical paralysis with no grave local infection.

Case 3 (W.O. 1829) is another illustration of local infection. There was a fracture of the third dorsal lamina on the right side, and a fragment of metal with some adherent khaki cloth had been driven into the spinal cord at this level. The cord is here quite soft and diffluent. There is a good deal of surrounding meningitis, and some two inches below the crush of the cord is a small patch of meningeal hæmorrhage about a millimetre in thickness, with surrounding œdema. The drawing (*Fig.* 126) shows the small piece of cloth below the metal fragment, and also a slight depression at the site of the more remote hæmorrhage. There was some extradural hæmorrhage. The direct cause of death was acute pulmonary œdema with bronchopneumonia and an infarct in the left lung.

FIG. 126.—Metal and cloth impacted in spinal cord; meningeal hæmorrhage and meningitis.

Case 4 (*Fig* 127, W.O. 2026) is a further illustration of the extent of the intramedullary destruction met with in nearly all direct wounds of the cord. A shell wound was received in the left loin opposite the 1st lumbar spine, and paraplegia was complete; 'laminectomy' was at once performed, and the large fragment shown in the drawing was removed from the spinal canal; but death followed the day after injury and within a few hours of operation. A large piece of cloth, not removed at operation, was found embedded in the cauda equina. There is complete destruction of all the nerve-roots and conus medullaris, with hæmorrhage and early acute meningitis, causing subarachnoid exudation as high as the upper part of the specimen. At the upper limit is shown a transverse section of the cord which presents a small hæmorrhage into the anterior cornu, and a second one beneath the arachnoid. In this case there was no time for the development of secondary urinary troubles, and death must have been the direct result of initial shock and septic infection. Few of the cases have been so quickly fatal, and the extent of the hæmorrhage into the cord and rapid spread of meningitis are well shown.

Case 5 (*Fig.* 128, W.O. 263) is an illustration of a wound in which the metal fragment

has passed tangentially to the spinal canal, but in which a fragment of bone has been detached and has given rise to a 'lodging wound'. A piece of shell passed from left to right across the back at the level of the 3rd and 4th dorsal vertebræ, penetrating the chest, wounding the apex of the right lung, and lodging in the right side of the neck. The right chest is described as having been found full of blood, but the duration of life is not stated, and there is no clinical history. In its course, the piece of shell has grazed the right laminæ of the 3rd and 4th dorsal vertebræ, detaching two small fragments of bone. These are seen to have been driven in, cutting the dura mater and partially dividing the right side of the spinal cord. There is here no direct septic infection of the theca or its contents, and the local conditions are therefore more like those of a simple fracture than of a gunshot wound with direct entry of the missile. Hence there is an absence of severe meningitis, and in many such cases there is also neurological evidence that the cord is only partially injured, so that the symptoms are often of the Brown-Séquard type.

FIG. 127.—Impaction of large fragment of metal and large piece of cloth in cauda equina; hæmorrhage and meningitis.

Case 6.—A similar example is furnished by a case which came under my own observation in France. There was a small clean wound on the right side of the neck, with paraplegia. On admission, the arms were folded on the chest with the forearms supinated. All four limbs and the intercostal muscles were paralyzed; there was no knee-jerk, and no sole reflex; urine was retained. Epicritic and protopathic sensation were lost, except that some vague deep sensation was retained in the right thigh. On the fourth day, when I saw the patient, he could feebly move all muscles of the left upper limb except those of the hand; in the right upper limb contractions could be defined in the deltoid and flexors of the elbow; there was slight power of moving the hips and flexing the ankles; the intercostal muscles were acting feebly but distinctly. Knee- and ankle-jerks were present and exaggerated; the sole reflex was extensor. The bladder could be emptied voluntarily. Anæsthesia of the trunk extended to the level of the cervical nerves; the right upper limb was anæsthetic, except on its outer side (5th segment); the left upper limb was anæsthetic only as high as the distribution of the 8th cervical or 1st dorsal segment. (The Brown-Séquard type of paralysis was thus indicated clearly in the upper limbs.) Some improvement continued for over three weeks, at the end of which time the medical officer operated, exposing the 4th, 5th, and 6th cervical laminæ. A small punctured fracture was found on the left side of the 5th cervical lamina, which was removed, exposing an opening in the theca adherent to the spinal cord. The adhesions were separated, when there was a free flow of cerebrospinal fluid. Respirations became very slow and feeble, and death occurred as the skin wound was being closed.

FIG. 128.—Impaction of fragments of bone in spinal cord; no septic infection.

The specimen (*Fig.* 129, W.O. 2472) shows a small metal fragment and a spicule of

bone derived from the 5th cervical lamina but lying just under the 4th. Both fragments have penetrated the theca, and have been carried slightly upwards to the left of the spinal cord, which is partially divided at about the level of the 6th segment. The fragment of bone is resting in the cord, the metal applied to the theca between it and the cord. There is no meningitis, and the area is apparently quite free from sepsis.

FIG. 129.—Impaction of metal in theca and of bony fragment in cord; no septic infection.

This case is of very great interest from several points of view. It illustrates the absence of marked secondary infective changes in many of the wounds due to clean fragments of metal or detached pieces of bone. The clinical symptoms were characteristic of this type of lesion. The case was one of the comparatively few examples in which laminectomy could have been of real value, and a successful result was to be anticipated. Without considering minutely the indications for such an operation, it is clear that a lodging wound presents a mechanical objective which does not otherwise obtain. Equally, if after recovery from the early stages of spinal shock there be limited symptoms with a tendency to recovery, the cord cannot be entirely destroyed, and it should be relieved of any foreign body or clot which is in contact with it. And again, the absence of vesical symptoms and of any obvious wound sepsis render such a case eminently favourable. Those present at the operation were unable to give me a clear account of why, in this unfortunate instance, it was directly fatal.

II. CASES IN WHICH THE MISSILE OR OTHER FOREIGN BODY HAS TRANSFIXED THE CONTENTS OF THE SPINAL CANAL.

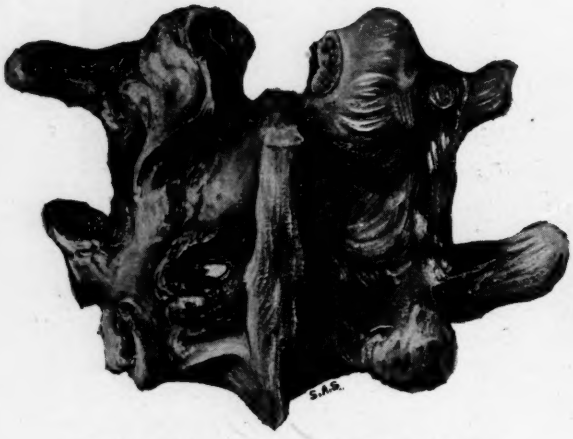

FIG. 130.—Entry wound through laminæ (*Case* 7).

FIG. 131.—Penetration of laminæ (*Case* 7).

In the preceding group we have cases in which some foreign substance has entered and remained within the spinal cord or its nerve-roots (lodging wounds), and we may now

turn to a group in which the mechanical cause of injury has passed on, leaving a similar wound with similar ultimate results, although the foreign body is no longer present.

Case 7.—In this case we have a whole series of specimens showing in detail a course of events which is quite common under such conditions (W.O. 594 A and 594 B). The patient was admitted to No. 9 General Hospital with a 'dirty-looking wound', about an inch in diameter, to the right of the spine at the level of the iliac crests. (A second through-and-through wound of the gluteal region is of no practical importance.) No vertebral injury was detected, and there is said to have been no paralysis and no alteration in reflexes. The man looked very ill, and, on admission, complained of pain in the neck; temperature 102°; the wound appeared to run towards the lumbosacral joint. On the following day abdominal pain was found to be due to a distended bladder, and, although small quantities of urine had previously been passed, he had retention to the end of life. On the third day he was very ill, with muttering delirium and a temperature of 104°. Lumbar puncture yielded a very small quantity of fluid under low tension; it was slightly turbid and gave a pure culture of streptococci. On the fourth day he died.

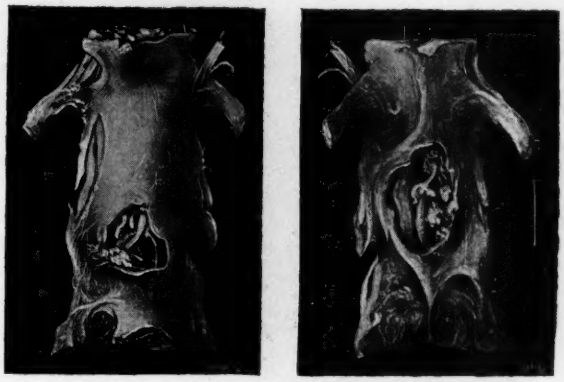

FIG. 132.—Penetration of theca and cord (*Case* 7).

FIG. 133.—Septic meningitis extending up entire cord (*Case* 7).

The autopsy was made by Captain Lazarus-Barlow. From behind there is seen (*Fig.* 130) a wound through the ligamenta subflava, between the 4th and 5th lumbar laminæ, and in this region a little pus lay outside the spine. Looked at from the front (*Fig.* 131) the specimen shows a small sharply-cut fracture of the 5th lumbar arch. The subjacent theca is cleanly perforated, and the cauda equina partly, but by

no means completely, torn (*Fig.* 132); the nerves and meninges in this region were blackened. Finally, the foreign body was discovered only on section of the vertebral bodies, which exposed a fragment of metal lying deeply in the 4th–5th intervertebral disc (*Fig.* 134). Meningitis extended upwards as far as the 1st dorsal vertebra, and the entire cord is here reproduced to show the extent of the exudation (*Fig.* 133). In addition to the intense congestion of the lower part of the meninges and of the medullary vessels, subarachnoid exudation is shown running up the cord, and we have a complete picture of a streptococcal spinal meningitis of four days' duration.

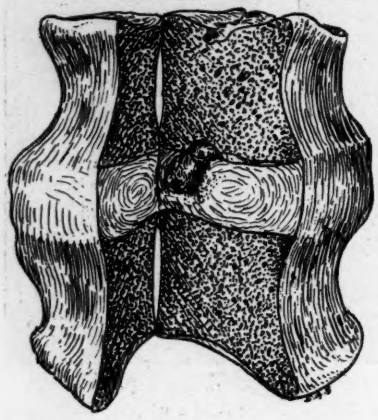

FIG. 134.—Lodgement of metal fragments (*Case* 7).

Case 8 (W.O. 350) shows a similar injury, with greater mechanical damage but far less serious septic infection. The theca is perforated transversely at the level of the 1st lumbar vertebra, and the cauda equina is almost torn across, a small fragment of bone still present (*Fig.* 135) showing the injury to have been due in part to the missile and in part to bony débris. There is little meningitis, though the post-mortem examination of other regions shows that life must have been preserved for some time. A bullet had entered the 9th intercostal space in the left mid-axillary line, passing through the pleura, the posterior margin of the spleen, and the middle of the left kidney, to the right lumbar region, whence it was extracted by operation. There was blood in the pleura and in the peritoneum, with slight fibrinous peritonitis, much perirenal hæmorrhage with purulent fluid in the retroperitoneal tissues, a fibrinous clot closing the wound in the spleen, pus around the resting-place of the bullet, cloudy swelling of the liver and right (uninjured) kidney, acute cystitis with hæmorrhagic foci, and œdema of the descending colon. Hence the specimen illustrates the severe mechanical injury and comparatively slight sepsis of a clean bullet wound of the vertebral canal.

FIG. 135.—Transverse section of cauda equina; little meningitis.

FIG. 136.—Section of spinal cord; slight secondary changes.

Case 9 (*Fig.* 136) shows equally a severe mechanical injury with slight meningitis. The bullet had perforated the arch of the 7th dorsal vertebra, transfixing the theca, almost dividing the cord, and then tearing a large ragged hole in the right lung. The drawing (*Fig.* 136) illustrates the condition of the medullary vessels in an early case of this type. (No clinical notes are obtainable.)

Case 10 (W.O. 411) illustrates a perforation in which life was prolonged for nearly a month. On Nov. 4, 1915, the patient was wounded by a piece of shrapnel on the right side of the neck, three inches below and a little posterior to the tip of the mastoid process. There was complete paraplegia below the nipple, but the arms are said to have presented no paralysis or anæsthesia. On Nov. 8, laminectomy was performed, and a fragment of shrapnel-casing measuring $\frac{3}{8}$ in.

by $\frac{1}{8}$ in. was found to the left side of the cord. The dura was torn, as were the posterior fibres of the spinal cord (*Fig.* 137). The wound healed aseptically, but paralysis was not improved, and death occurred on the twenty-eighth day. The very clean perforation is here represented by a glass rod, and it is clear that there has been no spreading meningitis.

FIG. 137.—Perforation of spinal cord; no septic changes. Result after one month.

III. CASES OF CONTUSION OF THE CORD BY DIRECT IMPACT OR BY TANGENTIAL WOUND.

In the two last groups of cases we have been concerned with injuries in which the missile or a fragment of bone has penetrated the dura mater and wholly or partially divided the spinal cord or its roots; we may now pass to those in which there has been no mechanical section, but in which the injury is due to a mere bruise. Such a bruise can be inflicted in one of several ways, which are illustrated by the following examples.

Case 11.—(*Fig.* 138, W.O. 2724). In this case, of which there are no clinical notes, a shrapnel bullet has impinged upon the 1st lumbar arch, and, entering the spinal canal, has come to rest on the right side, where it lies between the intact theca and the fractured lamina. It will be sufficiently obvious from the drawing how in such a case the cord is contused, and if the blow be sufficiently severe is converted into a mass of débris and blood-clot. This type of injury was rather common in the lumbar region, where the spinal canal is large, and was not infrequently due to shrapnel bullets of low velocity. Paraplegia naturally ensued, and the specimen is accompanied by the bladder and kidney, which well illustrate the usual method of death in such cases. The bladder, shown from its inner aspect (*Fig.* 139), presents intense congestion, with thrombosis of its veins and scattered patches of ulceration. The kidney presents numerous cortical infarcts, and should be compared with the kidney of *Case* 2, in which we have a quite different type of secondary lesion; in the latter the inflammation has taken the form of a hæmorrhagic pyelitis; in this instance (*Fig.* 140) the pelvis had undergone little damage, but the cortical metastatic lesions are well defined.

FIG. 138.—Lodging shrapnel bullet with contusion of cord.

Case 12 (W.O. 881) is an illustration of a slightly less obvious contusion, and presents several points of interest. *Fig.* 141 shows from behind a rifle bullet embedded between

FIG. 139.—Bladder from case shown in *Fig.* 138, inverted; cystitis, ulceration, thrombosis.

FIG. 140.—Kidney from case shown in *Figs.* 138, 139; cortical infarcts.

FIG. 141.—Bullet with base projecting into spine; fragments of casing shown in its track.

FIG. 142.—Projection of base of bullet into spinal canal tear of dura mater, contusion of cord.

the 5th and 6th dorsal spines. To the left of the bullet are seen bright specks of copper from its casing, and such are often of practical value, as they stand out as minute shadows in a skiagram and may usefully indicate the course taken by the bullet. In the present instance it is obvious that this has entered and has come to rest with its base in front. Turning now to the opposite side of the specimen (*Fig.* 142), we find that the base of the bullet has just failed to enter the spinal canal, but has here produced a salient, impinging upon the posterior aspect of the theca, in which are two small tears with a little hæmorrhage. The cord was here reduced to blood-stained débris.

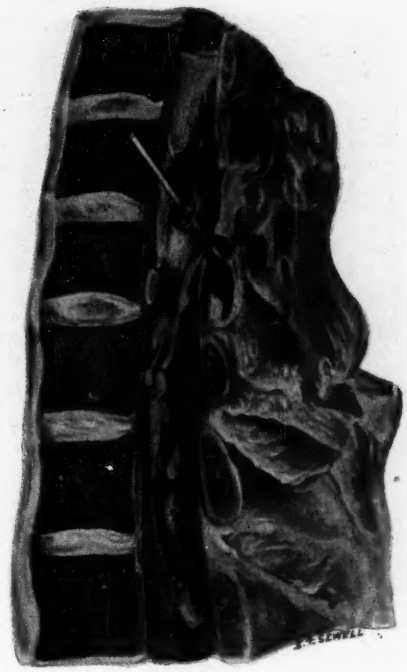

FIG. 143.—Tangential wound of meninges; contusion of cord (*Case* 13).

Case 13 (W.O. 384) shows a third form of contusion, in which the injury is tangential to the cord. A bullet entered one inch below the angle of the jaw on the left side and passed out to the right of the cervical spine. Its track is shown (*Fig.* 143) skating the arachnoid, which is here torn, and there is a thin layer of subarachnoid hæmorrhage extending for a considerable distance on either side of the glancing blow. The patient died on the third day, with complete paralysis and anæsthesia below the 8th cervical segment. In such cases the injury inflicted upon the cord is apt to extend far beyond the region of direct contusion, and the accompanying drawings (*Figs.* 144 and 145) of specimen 384 A are introduced to show how widely spread is the necrosis produced by the same bullet in the tissues of the back and at the point of exit. Even allowing for the fact that at this stage it would be accompanied by fragments of bone from the cervical laminæ, its 'divulsive' action has inflicted an amount of damage upon muscle, fat, and skin which fully prepares us for the widespread injury of the less resistant spinal cord.

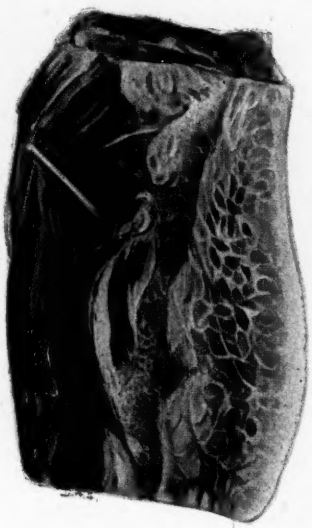

FIG. 144.—Track of bullet (*Case* 13); extensive hæmorrhage and necrosis.

FIG. 145.—Exit of bullet (*Case* 13).

Case 14 (W.O. 1433) is a further illustration of the result of a tangential injury, and is accompanied by a specimen of the aorta from the same case to allow comparison of a similar injury to these two very different structures. The bullet entered to the right of the 1st dorsal vertebra, passing through the spine, driving bony splinters into the hilum of the left lung, and then becoming embedded in the upper lobe of the latter, with its point projecting on the pleural surface. The patient, who was paraplegic, died in sixty hours with the symptoms of severe hæmorrhage. The left pleura was full of blood, and left lung collapsed. The aorta "seemed to have been untouched", but "lay immediately adjacent to the track of the bullet" (*Fig.* 147). On its inner aspect, at the point which the bullet had crossed, are a few minute cracks in the intima, and a small clot projecting like a polypus. As regards the spine, the bullet is found to have passed through a spinous process, grazing the left side of the dura mater, which presented a tear 1½ in. long (*Fig.* 146); the spinal cord showed no external change, but paraplegia was complete. (Another specimen shows the remainder of the spine with exit of the bullet through the left side of the body of the vertebra.)

FIG. 146.—Tangential wound of spinal cord.

FIG. 147.—Tangential injury of aorta from same case as *Fig.* 146.

Case 15 (W.O. 313) is an example of a form of injury which is probably quite uncommon. A bullet entered the left side of the neck just behind the centre of the sterno-mastoid muscle, and passed out immediately above the upper angle of the right scapula. Paralysis was complete, and death followed within thirty-six hours from respiratory failure. The bullet was found to have traversed the base of the 7th cervical spinous process, without penetration of the vertebral canal; but, on laying open the bones, there is here found a partial dislocation of the spinal column; between the last cervical and first dorsal vertebræ is seen a horizontal tear in the ligamenta subflava, and three or four of the vertebral bodies have been slightly wrenched apart into a position of hyper-extension. The whole of this region of the

FIG. 148.—Contusion of membranes and cord without penetration of vertebral canal.

spine thus presents an exaggeration of its normal anterior convexity; there is hyperextension of the cervicodorsal junction as from a severe but widely diffused impact upon the back of the neck; the divulsive action of the passing of a missile at high velocity is thus carried to an extreme degree, and the contents of the spinal canal have suffered from subluxation in extension instead of from the subluxation in flexion which is so characteristic of the injuries of civil life. (This bony specimen is in the museum, but the condition cannot be shown on a plane surface.) There was much diffused hæmorrhage into and around the bones, and the vertebral canal was palpably full of blood.

FIG. 149. — Contusion of cord; no injury to theca.

The specimen (*Fig.* 148) illustrates admirably the usual appearances of extensive hæmorrhage into the membranes and cord. It is important to note that in this and other similar cases the amount of hæmorrhage, although sufficiently great having regard to the region in which it is situated, is rarely if ever sufficient to fill up the theca or to yield any large amount of blood from lumbar puncture. Cerebrospinal fluid obtained by the latter means may present slight reddening or may show blood-cells microscopically, but we have not found such quantities of blood as to produce any direct pressure in distant parts of the theca.

FIG. 150.—Extensive softening of cord from contusion; no injury to theca.

The above cases illustrate the *mechanism* of contusion of the spinal cord; those which follow show some of the *results* of such injury.

Case 16 (W.O. 469) is an example of severe hæmorrhage from contusion in the cervical region. The bullet entered the right side of the neck behind the sternomastoid muscle, splintering the right lamina of the 7th cervical vertebra and coming to rest in the muscles of the back near the 1st dorsal spinous process; from its short course and ready arrest its velocity was probably low. The theca is quite uninjured, but there is extensive hæmorrhage in the arachnoid and cord, extending well above and below the region struck (*Fig.* 149). It is noteworthy, however, that in this instance, in which the velocity was probably not high, the hæmorrhage is far more localized and well defined than in most of our cases.

Case 17 (W.O. 2027) is that of a man who died six days after a wound in the neck. There was a fracture of the 6th and 7th cervical spinous processes and laminæ, with complete paraplegia, hyperpyrexia, and pneumonia. The post-mortem examination showed a large amount of extradural blood-clot extending over the lower cervical region and reaching to the upper dorsal vertebræ; but the theca was untorn, no foreign body was found in the spinal canal, and there was no meningitis or intrathecal hæmorrhage. The specimen (*Fig.* 150) shows an extensive area of softening in the lower cervical region. In this case it is

possible that there may have been a direct bruise of the contents of the vertebral canal by bony fragments which have subsequently recoiled; or alternatively, the bruise may have been due to the divulsive effect of the bullet upon surrounding soft parts, as shown in *Case* 13. The lesion of the cord is not of a type which could be produced by the mere pressure of extrathecal hæmorrhage.

FIG. 151.—Slight bruising of theca; extensive injury to cord.

A similar condition is better shown in the coloured drawing of *Case* 18 (W.O. 2072). Here death occurred on the sixth day after a wound in the middle line over the 2nd dorsal spinous process causing complete paraplegia. At the post-mortem was found a fracture of the 2nd dorsal spinous process, and a piece of metal one and a half inches in length, with some fragments of cloth, was embedded in the left lamina of the 4th dorsal vertebra, at which point it had projected slightly into the spinal canal without dividing the theca. There was an extradural hæmorrhage, with some pus, over an area four inches in length. (Other post-mortem findings were cystitis, pyelitis, œdema of the lungs, and some gas infection of liver, spleen, and kidneys.) The specimen (*Fig.* 151) shows a slight indentation of the dura opposite the 4th dorsal lamina, with remains of the extradural coagula, and contusion of the cord with numerous hæmorrhages into its substance extending over an area of about four inches. It is here obvious that any direct bruise can only have occurred in the lower part of the damaged area, while the more severely injured part above could only be affected by transmission of the mechanical impulse through soft tissues or unbroken laminæ.

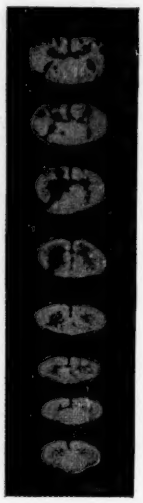

FIG. 152.—Extensive hæmorrhage from slight bruising (or concussion) of cord.

Lastly, in *Case* 19 (W.O. 451) we have a case in which a shell wound in the cervico-dorsal region caused a fracture of some of the spinous processes, but did not open the vertebral canal. A series of sections taken over a distance of three inches (*Fig.* 152) shows admirably the extent of hæmorrhage into the cord in such a case of contusion, or as it is sometimes called, 'concussion'. The bleeding, which is more severe on the left side, shows a marked tendency to affect the grey matter rather than the firmer white fibres, and takes the general form of a much tapering spindle, an arrangement which is also commonly seen in the hæmorrhage which extends above and below the crushing injuries of fracture-dislocations in civil life. The same arrangement can be demonstrated clinically to have occurred in many cases which recover, leaving an atrophic paralysis of certain segmental areas, with little evidence of injury to ascending and descending fibres.

MENINGITIS.

Reference has been made in several of the above cases (notably *Case* 6) to the adhesions by which apertures in the theca may be sealed as are aseptic wounds of the cerebral membranes. Such local repair can, however, occur only in the absence of septic infection, the adhesions produced are generally very feeble, and the theca presents great powers of complete repair. It is quite usual for the separation of such adhesions to be

followed by a gush of cerebrospinal fluid, and in many cases this release has been described at operation as due to the opening of a subarachnoid cyst. In some, no doubt, there is a localized collection of fluid, but in others there is merely a release under normal tension

FIG. 153.—Extension of septic meningitis upwards along cord.

FIG. 154.—Lower part of cord from same case as *Fig.* 153, showing extent of meningitis.

of the fluid above and below, and it is not unusual for such fluid to be projected for a vertical distance of several inches through a small incision in the arachnoid.

In gunshot wounds there is, however, a grave risk of septic infection, and many of the above cases illustrate the appearances produced by such local infection. The dura

is reddened and congested, while exudation within the arachnoid covers the surface of the cord with a creamy layer of pus. Definite abscesses are rarely if ever found, and I have not met with any evidence of local accumulation of gas, probably because death precedes the development of such conditions.

The meningitis presents a strong tendency to spread, which is well shown in *Case* 20 (W.O. 1832) (*Figs.* 153, 154). This man was admitted to hospital with a through-and-through bullet wound passing from right to left across the back at the level of the 12th dorsal vertebra. He presented complete flaccid paralysis of both lower limbs, with paralysis of bladder and rectum. All power of sensation was lost from (? including) the 1st lumbar segment, except a small triangle under Poupart's ligament on the left side. There was a fracture of the spine, of which the exact nature is not described. Laminectomy was performed the day after the wound, and the cord was exposed through the 12th dorsal and 1st lumbar laminæ. On the ninth day there is a note reading, "Meningitis—general condition worse—paralysis never improved", and on the twenty-third day he died. Supplementary clinical notes, which unfortunately bear no date, refer to diminution of sensation of touch and pain below the 5th dorsal segment, hyperæsthesia to rubbing in both flanks, weakness of the lower part of the rectus abdominis, and exaggeration of abdominal reflexes on the right side with diminution on the left.

FIG. 155.—Septic meningitis with much exudation.

The post-mortem examination by Captain T. H. O. Shore showed extradural hæmorrhage extending from the wound up to the mid-dorsal region, intradural hæmorrhage and purulent meningitis to the upper dorsal region, and softening of the cord about the wound. In the brain there was extensive purulent meningitis, with pus in the ventricles and a small hæmorrhage in the floor of the 4th ventricle. It is noticeable —especially in connection with the next case—that extensive as is the spinal meningitis, it tends to fade away in the upper part of the thecal canal, while it is again more active in the cerebral meninges. Also it is here remarkable that the extension has occurred solely in an upward direction, the subarachnoid space below the lesion having apparently been sealed off by adhesions (*Fig.* 154). Such a distribution is quite usual, and for this reason a thecal puncture below the level of the lesion may fail to indicate the severity of the meningitis above.

In the great majority of such cases of meningitis—which are probably due to a streptococcal infection as in *Case* 7—the inflammation is, as would be expected, directly continuous; but the following is a remarkable illustration of what might at first sight appear to be a separate focus of infection.

Case 21 (W.O. 468) is that of a man who had received two wounds thus described in the post-mortem report by Captain Hubert Henry, 13 General Hospital, Boulogne: (1) "A large gaping septic wound over lower lumbar region in middle line, with tearing of the base of the dural sac"; (2) "A second smaller wound over 10th and 11th ribs, two or three inches to right of mid-dorsal line", slight and superficial. There was no head injury. The note adds: "Said to be a case of pure infection with *B. perfringens*". No clinical history is obtainable.

The lumbar region of the spinal cord (*Fig.* 155) shows a typical area of septic meningitis, with the usual accumulation of pus beneath the arachnoid, and with prominent congested vessels in the cord; the dura mater presents little if any change. On the vertex of the brain there is another area of similar inflammation (*Fig.* 156). There is

here a thick deposit of densely-packed yellow pus with well-defined margins, almost limited to the vertex but extending slightly towards the Sylvian fissures. The post-mortem report states that "there is little evidence of meningitis at the base"; the specimen shows none, nor does the upper part of the spinal cord. This is the only case in which we have found so isolated a patch of remote meningitis, but there is no

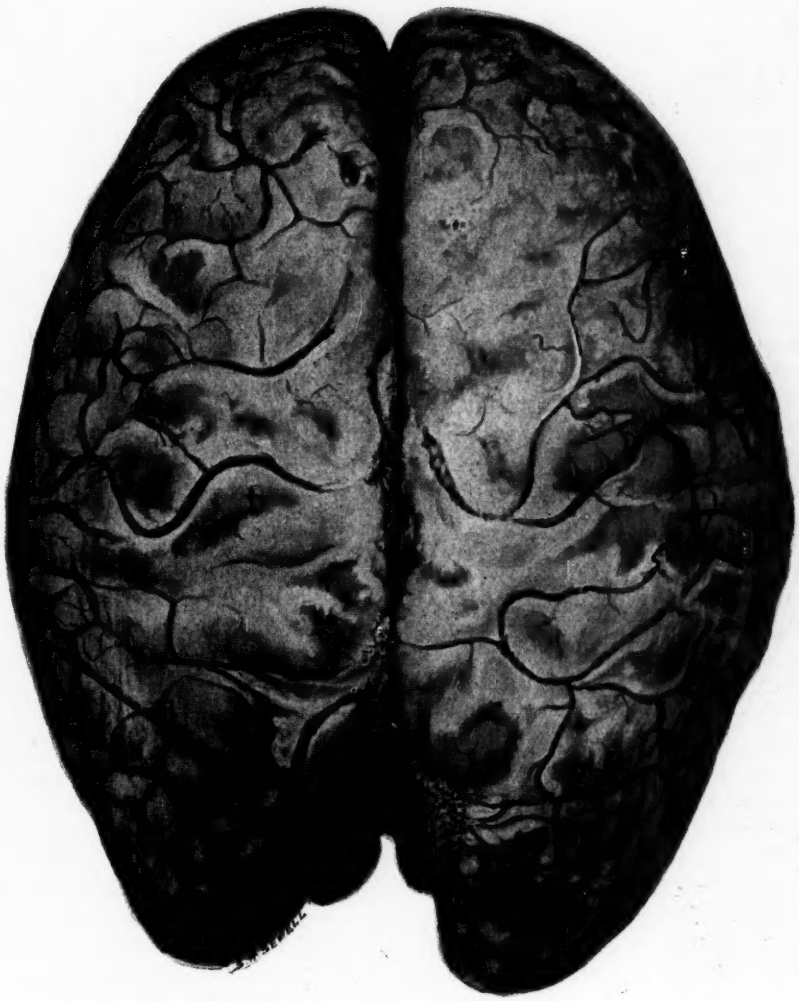

FIG. 156.—Brain from same case as *Fig.* 155, showing vertical meningitis.

reason to regard the condition as a pure metastasis; it probably resulted from a direct extension of infection which has failed to evoke active reaction at lower levels, and has thus, by allowing life to be prolonged, had the opportunity to develop to an unusually high degree at its upper limit, a tendency to remote exacerbation also seen in *Case* 20.

SUMMARY.

In concluding this survey of a selection of specimens from the very fine collection in the War Museum, we may perhaps lay down the following general propositions :—

Gunshot injury of the spinal cord may be due to :—

1. The direct impact of a missile, which may either penetrate it completely, or remain embedded in it, and which is liable to be accompanied by fragments of clothing, and especially of bone.

2. The indirect impact of fragments of bone, which again may penetrate completely, may remain embedded, or may recoil towards the positions from which they were dislodged, although such recoil is far less common and less obvious than in fractures of the vertebral bodies as seen in civil life.

3. Contusion by : (*a*) Foreign bodies which enter the spinal canal but do not penetrate the theca ; (*b*) Displaced fragments of bone protruding slightly into the vertebral canal ; (*c*) Displacement of the soft parts only, or, rarely, subluxation of the bones (*Case* 15)—the widely-spread divulsive or 'explosive' action of a missile passing by at a high velocity.

In all cases the cord is liable to present mechanical destruction and hæmorrhage extending widely beyond the area of apparent injury, and affecting especially the grey matter of the anterior cornua, where it produces long spindle-shaped areas of destruction. Such extension of hæmorrhage is more widely spread where the missile is of higher velocity.

In the case of direct impact by foreign bodies, septic meningitis will generally ensue, but such meningitis is less common when impact is due only to fragments of displaced bone. It is generally absent in contusions of all forms, and the untorn dura mater is highly resistant to infection.

Meningitis tends strongly to extend upwards rather than downwards, and is usually continuous, but may spread unobtrusively along the membranes, to blaze up at remote points.

Hæmorrhage sufficient to cause serious compression is very rare, but it is usually present in such quantities that, should life be prolonged, it may readily give rise to well-defined cicatrices, which will tend to assume the annular and constricting type often found at operation.

REFERENCES.

[1] Thorburn and Richardson, *Brit. Jour, Surg,*. 1918, vi, 481.
[2] Keith and Hall, *Ibid.*, 1919, vii, 67.

VISITS TO SURGICAL CLINICS AT HOME AND ABROAD.

SIR ARBUTHNOT LANE AT GUY'S HOSPITAL.

THE second number of this JOURNAL contains an account of Lane's technique in open operations for fractures of the long bones, and in a later issue Lane described the details of his operation of colectomy. While on the one hand these articles somewhat limit the scope of the present paper, yet they allow of the omission of a quantity of technical detail, and permit of attention to general principles which, as in this instance, can be picked up by repeated visits to the clinic of an original-minded surgeon.

The present writer has so long observed Lane's work that he can recall the phase of his interest in mastoid surgery, which attracted attention in 1889 by the publication of five cases of lateral sinus thrombosis treated by operation; priority in this field must be accorded to Horsley, in this country, who recommended ligature of the jugular in 1886 and carried it out in 1888, but it is believed that Lane's was the first British paper in which actual cases were recorded.

To Lane must be given credit for resection of ribs for the drainage of acute empyemata in children which, up to the time of his paper in the Guy's Hospital Reports of 1883, had, when treated surgically, been drained by an incision through an intercostal space.

On a recent visit Sir Arbuthnot Lane dealt by open operation with a T-shaped fracture of the lower end of the humerus in a youth.

It has been the custom of many critics of Lane's work to assume that he makes a practice of operating on every fracture: this is not a fact. Lane holds very strongly that good anatomical reposition is an essential in the treatment of fractures, and it may be that his definition of 'good' in this relation has a higher value than would be required by some other surgeons; but as one who has had the opportunity of following his practice in the treatment of fractures, the writer can confidently assert that operation is undertaken only when the ordinary non-operative measures fail to restore the normal position or to maintain it. In the case under consideration an attempt had been made under an anæsthetic to reduce the deformity; but this failed, and x rays in two planes confirmed the opinion that no improvement had resulted.

The transverse limb of the T was supracondylar, and the vertical limb ran downwards and inwards through the trochlea; of the two lower fragments the inner was very small and mainly intra-articular. With a thin four-hole plate the outer lower fragment was brought into normal relationship with the shaft. The skin wound was closed with Michel's clips, without any ligatures or suture of the deep tissues. Lane attaches importance to the placing of these clips very near together throughout the whole length of the skin wound; by this the escape of blood is prevented and any risk of infection from the surface is avoided.

In the after-treatment of such cases massage is employed as soon as the wound is healed and the clips are removed; no passive movements are allowed, but active movements are encouraged from the date at which normal union occurs in simple fractures, i.e., after about four weeks in the case of the humerus. This patient was able to carry out active, painless, free movements through ninety degrees after some eight weeks under such treatment.

Lane does not think that operative treatment of simple fractures exercises any delaying influence on union; he holds that in compound fractures—and this is particularly true of old gunshot fractures—such delay in union is due to septic infection of the bone itself. This is particularly important in the case of the femur, and necessitates the wearing of a caliper, or some similar apparatus such as a Hœfftcke's splint, for some months.

Only simple fractures are subjected to early operation; if in a compound fracture the displacement cannot be controlled by splints, the wounds are allowed to heal and no operation is undertaken until some weeks have elapsed after firm union of the wound; this is an interesting reflection upon the early attitude of the profession to Lane's intro-

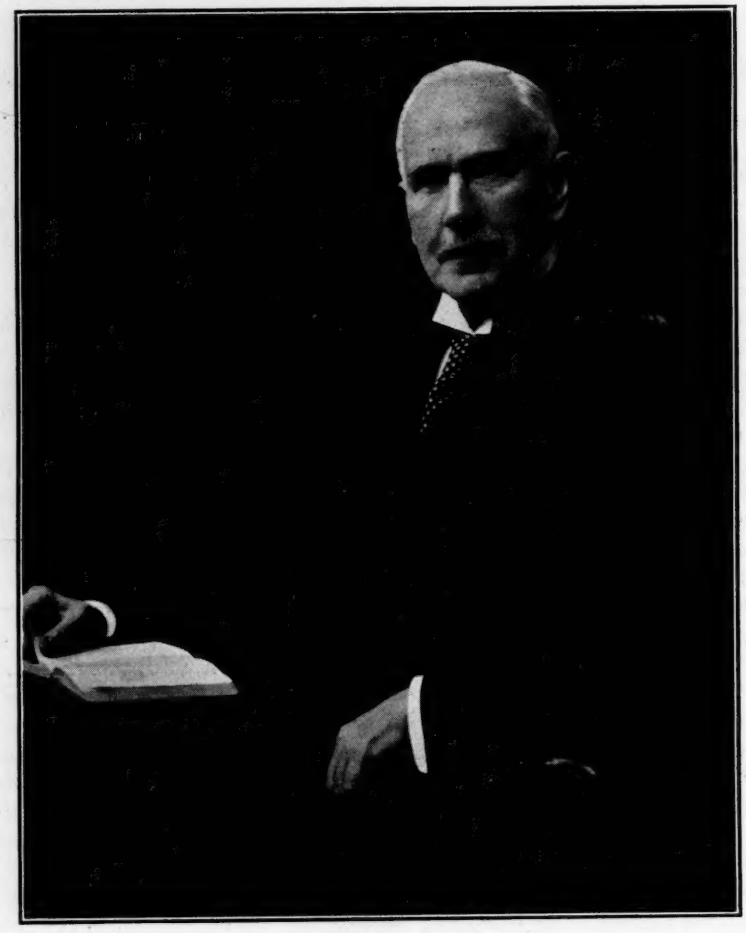

FIG. 157.—Sir Arbuthnot Lane.

duction of the operative treatment of fractures, for there was a wider tendency to concede its application to compound than to simple fractures, as it was admitted that a wound already existed in the former, and the supposed risk or danger of converting a closed into a compound fracture did not exist.

When dealing with fractures of the lower extremity, particularly in late cases, much overlapping of the fractured bone is brought about by muscular shortening; this is exceptionally marked in the femur. In order to overcome this, Lane frees the two ends subperiosteally for some distance, and then, in the case of the femur, has the limb below the fracture strongly adducted; the two ends are then brought into apposition, and the limb is straightened, when the shortened muscles are stretched by the leverage of the bone

without much effort of pulling by his assistants. It is remarkable, on observation of this simple method, how easily shortening is overcome, so that much less bone has to be removed in order to get good alinement than might have been imagined.

Lane has repeatedly demonstrated from *x*-ray plates of fractures plated some months or years previously, that plates and screws do not cause bone absorption or rarefaction, provided the parts remain sterile. In all such aseptic bones there is no area of abnormal translucency around the screws, and if for any mechanical reason such as the vicinity of the plate to a joint or the growing end of a bone its removal is desirable, the screws will have to be removed with a screwdriver, as the screw-thread in the bone is maintained indefinitely.

Lane has perfected his 'no touch' technique by long practice, and a visit to him is well repaid in observing how, through a long and tedious afternoon occupied by two or three bone-platings, he has trained his assistants to carry out this practice so that failures are very rare indeed.

At the time of my visits Lane was interested in the causation of abdominal adhesions after laparotomy, and particularly after intestinal resections such as colectomy. He held that preservation of the omentum was an important detail, and in recent years modified his technique with this object in view, though he often remarked that in cases of stasis the omentum was usually defective both in length and size. He had been experimenting with the use of various fluids for the protection of the intestines so as to obviate the formation of adhesions, and for a long period all swabs and towels which came into contact with the bowel-wall were saturated in liquid paraffin; but after prolonged trial it was found that their use exercised no protective influence against the formation of adhesions.

To those who, like the writer, have had the privilege of watching the gradual evolution of Lane's colectomy technique, his very small operative mortality is no matter for surprise; having seen this on scores of occasions, I have never left the theatre without regret, and a feeling that one had seen something done as well as it could possibly be done. It surely is the master alone who through long years can inspire his juniors with increasing admiration, both for the ingenuity of his view-point and the dexterity of his manipulations. Lane's colectomy technique has not noticeably altered since he described it in the eighth number of this JOURNAL, where the reader in search of detail will find all that he needs. It seems that Lane's perfection as an abdominal technician rests on the following points:—

1. His free incision, permitting adequate exposure of organs, their inspection and palpation providing an education in the 'pathology of the living' which most of his predecessors lacked, and which even some of his critics have failed to take advantage of in their own education. Most abdominal operators in Casualty Clearing Stations during the war learnt to do what Lane had done for years: this makes for avoidance of trauma and shock. If one analyses one's experience of tragedies witnessed in abdominal surgery, they owe seventy-five per cent of their difficulty to too small an incision.

2. Speed. Lane does not strike the casual observer as a rapid operator, yet the colon is often removed, ileocolostomy performed, and the peritoneal cavity closed, well within an hour; this is possible owing to every act being purposeful, and an entire absence of haste.

3. After end-to-side ileocolostomy had failed, and even a secondary colectomy combined with this method of anastomosis failed to obviate the objectionable regurgitation into the blind colon and its enormous dilatation, Lane made a real advance in intestinal surgery which may have a very wide application, when he showed that the small may be joined to the large bowel without risk by an end-to-end anastomosis; this is the method he has adopted for some years, and, following his example, many surgeons have realized that axial anastomoses of the large bowel possess no special risks when the technique of their performance is based on sound surgical principles.

4. Lastly, there are two points of greater importance than is at first apparent:—The first is the use of continuous axillary saline during and subsequent to the operation. Lane holds that this minimizes shock (and certainly the pulse-charts of a series of

colectomies support this idea), and also by maintaining the blood-pressure diminishes post-anæsthetic vomiting. The second is the insertion of a rectal tube through the anus to a point in the ileum well above the anastomosis, with the object of preventing flatulent distention in the region of the anastomosis.

On the last occasion on which I saw him work, Lane had to deal with a small infant with a single harelip and palate cleft; the hard palate was closed by Lane's flap method, the mucoperiosteal flap on the side of the cleft being turned over, hingeing on its mesial border, and that covering the half of the palate to which the vomer was attached being swung inwards with a hinge behind so as to cover the first flap. In turning over the hinged flap care is taken to preserve the descending palatine vessels.

The soft palate was left for a second operation, and the lip was sutured. Adhesions between the lip and gum is one of the worst features of an unsatisfactory operation, and to avoid this Lane makes use of the margins of the harelip in the following way:—The margins are incised from the anterior surface through about three-quarters of their thickness just outside the junction of the pink mucosa and skin; the flaps so formed are turned backwards and everted; they are retained in this position by catgut mattress sutures, bringing the raw surfaces into apposition; this ensures an abundant mucous covering to the deep surface of the lip and also increases the thickness of the opposed raw surfaces. The two raw edges of the cleft are then brought together with a buried continuous catgut suture, and the skin with interrupted sutures of gossamer gut.

In the writer's opinion the flap operation has a very definite field in the closure of clefts of the hard palate for cases for which no adequate alternative exists; this view may not be generally accepted, but it must be admitted that Lane's ingenuity and writings on this branch of surgery have favourably influenced the practice of most of those interested in such cases, in that they now operate at a much earlier date, so that, as Lane pointed out, the normal conditions of nasal respiration are established, and therefore the nasal cavity is, at as early a date as possible, brought under influences which favour its normal growth and function.

Most of the visitors to Lane's clinic have listened to his exposition of his views on surgical conditions which were engaging his interest at the time; these were always expressed with characteristic originality of view-point and with an almost mesmeric enthusiasm; thus it will be readily understood that all the best of the senior students at Guy's have been attracted to his 'firm' as house surgeons; but to the multitude he did not appeal as a teacher for, in the ordinary sense, he had no command of 'the spoken word,' and indeed never concealed the fact that the majority of conditions which fill the surgical beds of the large hospitals had no interest for him, so that for some time his hospital practice has been almost entirely confined to abdominal surgery, operations on fractures, and cleft palates.

There is much to be said for this attitude provided it is not generalized to the whole surgical staff. Lane has the true researcher's mentality and originality, and, quite apart from his many original observations and methods, his influence on the practice and surgical outlook of his juniors at Guy's, which has been vastly greater than that of any of his contemporaries in the last thirty years, will exist for many years to come, and is perhaps one of his chief causes for self-satisfaction.

Of the present staff at Guy's, nine engaged in general or special surgery have worked under him as house surgeons, and without doubt each of them would attribute all his knowledge of surgical cleanliness, and a very large proportion of his technical skill, to Lane's practice and example.

A VISIT TO THE CLINIC OF PROFESSOR HENRI HARTMANN, AT THE HÔTEL DIEU, PARIS, JULY, 1920.

A SMALL, well-built, swarthy-complexioned man, with hair and beard once jet black but now more than grizzled, is Henri Hartmann, Professor of Clinical Surgery in the University of Paris, and Surgeon to the Paris Hospitals. Formerly attached to the Lariboisière Hospital when he was but an *agrégé* he has now for the last nineteen years served the

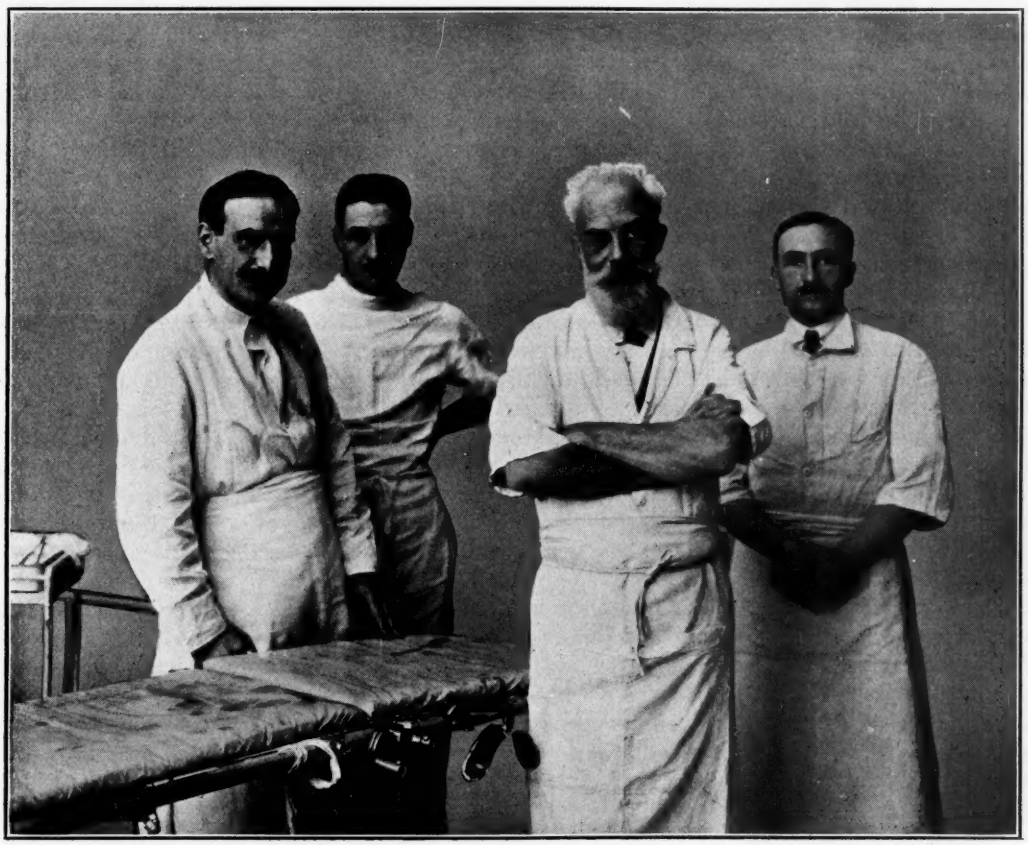

FIG. 158.—Showing Professor Hartmann in the operating theatre with his three assistants, Drs. Bergeret, Gouverneur, and Huet.

Hôtel Dieu, that hospital on the banks of the Seine which, from time immemorial, has been under the shadow of the great cathedral of Notre Dame, in the very heart of the city, in much the same way that St. Bartholomew's Hospital in London has always been overshadowed by St. Paul's.

Hartmann is well known as a pioneer in abdominal surgery. His early work on the

stomach was done in collaboration with his master, Prof. Terrier, whilst that on the rectum was published with Prof. E. Quénu. As early as 1901 he published a valuable course of lectures on *Gastro-intestinal Surgery*, and in 1913 he was selected to receive the Honorary Fellowship of the Royal College of Surgeons of England. Like the rest of his surgical colleagues in Paris, he welcomed all members of the International Society of Surgery to his operating theatre, and willingly showed them his wards, laboratories, and teaching apparatus. Accordingly, on a blazing July morning a considerable number of English, American, Danish, Swedish, and French provincial surgeons assembled at the Hôtel Dieu and watched him perform : (1) A total hysterectomy with removal of both ovaries, one of which was converted into a large ovarian cyst ; (2) A cholecystectomy for gall-stones ; (3) Excision of a gastric ulcer situated upon the lesser curvature. The operations were timed to begin at 9.30 a.m., and five minutes before the time the Professor was stripped and was systematically scrubbing his hands under running water. Punctually to time the patient was placed upon the operating table, having been anæsthetized in a small room adjoining the theatre. The transference from the trolley to the table was effected by a single porter, who lifted the patient knees and shoulders together, and so removed him when the operation was finished. The surgeon, with one assistant, was wearing a sterilized short-sleeved gown, with cap and mask, and a pair of rubber gloves, thicker than those used in England and reaching to the middle of the forearm. The sister in attendance was dressed more coquettishly than would have been allowed by the matron of a British hospital, with high-heeled white shoes, but she was quiet, alert, and evidently skilled in her duties. She wore no gloves, and took no part in the operation except to hand such things as were needed by means of a pair of duck-bill forceps. The instruments were taken straight from the sterilizer and laid upon a dry towel ; the only lotion used was a bowl of sublimate for the surgeon's hands. No students were present, though there was ample space railed off for them in the theatre. No shoes were changed nor goloshes worn, but a gown was provided for each spectator.

Each operation was performed rapidly, but without hurry. The hysterectomy, which included the tapping of a large ovarian cyst, began at 9.35, and the patient left the table at 10.13 ; the cholecystectomy commenced at 10.20, and was completed at 10.43 ; the operation for gastric ulcer began at 10.52, and the last suture was tied at 11.35. Each operation was carried out through a large incision, oblique and along the lower border of the ribs in the case of removal of the gall-bladder and exploration of the stomach. The hæmostases were remarkably complete, owing to the care with which the main vessels were ligatured before the branches were divided. This appears to be a feature of French surgery, for there was the same conservation of blood in the operations of other surgeons. Sterilized catgut was used for the ligatures and for suturing the peritoneum : chromicized for the abdominal walls. Silk was employed for the stomach sutures. The cholecystectomy wound was closed in three tiers, but the abdominal wound on the left side was closed with only a single row of sutures passing through the skin and the whole thickness of the muscle and peritoneum. The skin was brought together by silkworm-gut sutures inserted with a Reverdin's needle, the sutures being reinforced with Michel's clips. Each wound was drained by means of a large rubber tube ; a dressing of white gauze and wool was applied, and was kept in place by a binder. The anæsthesia was complete during the operation, but the patient was recovering before the trolley left the theatre.

Adjacent to the theatre is a library and a small museum, both personal to the Professor. The rough notes of each case are written by a student, but Prof. Hartmann stated that the detailed account of each operation is written by himself. Each set of notes is numbered serially. The present number is nineteen thousand odd, and as Prof. Hartmann is now in the nineteenth year of office it is clear that the average number of operations which he performs is one thousand a year from a service of 140 beds. In like manner the museum contains the specimens he has removed, which are numbered like the notes, so that there should be no difficulty in obtaining quickly the history and clinical details of each preparation.

The Hôtel Dieu was rebuilt unfortunately between 1868 and 1878, before the principles of modern hospital construction were understood. The wards, therefore, are too massive, and are somewhat deficient in light and ventilation as judged by modern standards. The patients looked well, and the temperature charts showed that the operations ran an aseptic course. A stone balcony runs along the whole length of the wards, and on it, we were told, the beds could be wheeled on fine days.

At the end of the wards is a room devoted to books, and in this room Prof. Hartmann has gathered together a large number of pamphlets arranged in loose covers and labelled according to their subjects. It is thus possible for a student to consult the most recent literature on topics which interest him. Attached to the clinic is a pathological department especially devoted to the study of cancer.

It would thus appear that at the present time in Paris the surgical services are decentralized as far as possible. The office of surgeon to the Hôtel Dieu, as in England, is a part-time office, but the clinic is complete in itself, and not, as with us, a part of a central institution, because the notes, the pathological specimens, and the library are directly under the control of Prof. Hartmann.

SHORT NOTES OF RARE OR OBSCURE CASES.

GUNSHOT WOUND OF FOREARM MASKING SYMPTOMS OF CERVICAL RIB.

By C. P. G. WAKELEY, London.

A. P., a pensioner, age 25, was sent from the Pensions' Board for massage and electrical treatment to the Pensioners' Clinic at King's College Hospital in July, 1920, with an old gunshot wound of the right forearm.

He gave the following history. He was wounded in the right forearm in June, 1918, a piece of shrapnel entering about three inches below the elbow and lodging between the radius and ulna. The wound healed well and the metallic fragment was left *in situ*.

FIG. 159.

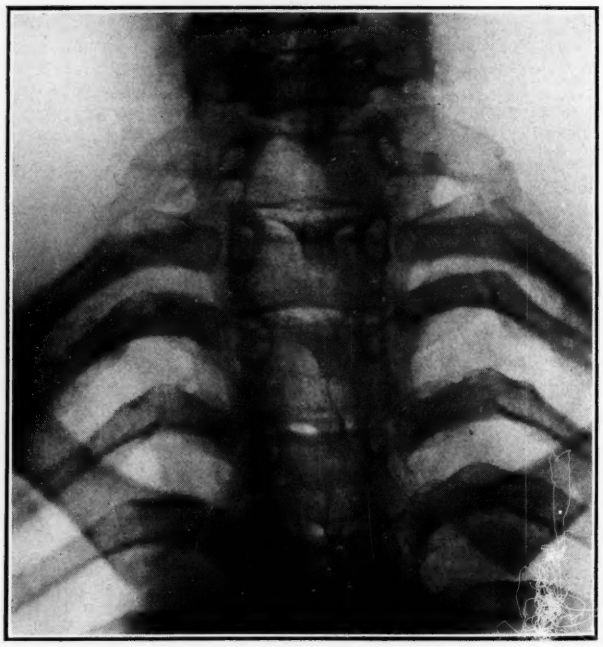

FIG. 160.

The patient was ordered massage treatment when the wound had healed, and, owing to some loss of power in his grip, had continued massage at various hospitals for the last two years. He was not getting any better; if anything, he considered that his grip was gradually becoming less.

On examining the patient, a well-built man, the muscles of the right forearm were in excellent condition. There was a small entrance wound in the centre of the forearm

which had healed without any scarring. There was some wasting of the intrinsic muscles of the hand, especially the first dorsal interosseous. An *x*-ray photograph of the forearm (*Fig.* 159) demonstrated one large and two small pieces of metal between the radius and ulna, there being no abnormality of the bones. The clinical condition did not correspond to a lesion of the ulnar nerve.

Owing to the wasting of the first dorsal interosseous it was decided to have a skiagram taken of the cervical spine to see if there was any trace of a cervical rib, although such a condition could not be ascertained clinically, and nothing abnormal could be palpated in the neck. The skiagram showed that cervical ribs were present on both sides, that on the right being the larger (*Fig.* 160). It is a curious fact that cervical ribs do not give rise to symptoms until between the ages of 20 and 30 years. Tubby[1] states that in 29 cases of cervical rib the average age when attention was drawn to the condition was 27 years. But following the introduction of *x*-ray examinations cases are now diagnosed earlier. Tubby operated on a child 2 years old. In the above case the disability was not due to military service, and the patient should not be drawing a pension.

It is interesting to note that this man's sister had bilateral cervical ribs which did not cause any symptoms until she was 23 years of age. Excision was performed on both sides, with a good result.

REFERENCE.

[1] *Deformities*, Macmillan & Co.

INTUSSUSCEPTION OF THE VERMIFORM APPENDIX.

By A. J. BLAXLAND, Norwich.

Intussusception of the appendix in an adult is a very rare condition, and only a few cases have been recorded. One case of partial intussusception in a woman of 50 was recorded by M'Connell and Wilson in this journal in April, 1914, and another case of complete inversion in a man of 60 was recorded by Burghard in the same number.

The case that I record is that of a man of 63. The appendix had become completely turned inside out and had drawn the bowel up with it, resulting in an ileocolic intussusception—the commonest variety according to Moschowitz.[1]

The history of this case suggests that the invagination of the appendix took place gradually over a period of several weeks, and caused no symptoms of consequence until the cæcum became implicated in the process, when acute symptoms at once became evident. In the absence of the passage of blood per rectum, the cause of the intestinal obstruction could not be diagnosed prior to operation, but the detection of the abdominal tumour enabled the selection of the most suitable incision for laparotomy to be made.

The patient, a man 63 years of age, was sent to the Norfolk and Norwich Hospital on April 3, 1920, by Dr. Sturdee, of Walsingham. He had had 'grumbling' pain in the right side of the abdomen for six weeks; two days before admission to the hospital the pain had been acute and he had vomited frequently. Enemata had been given without result.

On admission the patient looked very ill; the temperature and pulse were subnormal. The abdomen was moderately distended, and there was some general rigidity. An indefinite tender lump could be felt under the middle of the right rectus. Rectal examination revealed nothing abnormal. There was no blood on the examining finger.

A couple of hours later an exploratory laparotomy through the right rectus at once revealed the presence of an intussusception. The apex of the intussusceptum lay in the middle of the transverse colon. It was freely movable, about the size of a man's thumb, and consisted of the appendix completely invaginated.

The cæcum, the lower half of the ascending colon, and a portion of the ileum, which formed the proximal part of the intussusceptum, were reduced by manipulation without

much difficulty, in spite of considerable œdema of the cæcum. On the inner and lower aspect of the cæcum could then be seen a dimple corresponding in situation to the base of the appendix, and this organ, inverted and much thickened, could be felt easily, lying in the cæcum.

As it was obvious that further manipulation would be useless, an incision was made into the cæcum on its outer wall and was carried around the root of the appendix, which was thus removed. The opening into the cæcum was closed with a double layer of silk sutures, and the laparotomy wound closed.

Except for an attack of gouty arthritis in both ankles a week after the operation, the patient made an uneventful recovery and returned home on April 23.

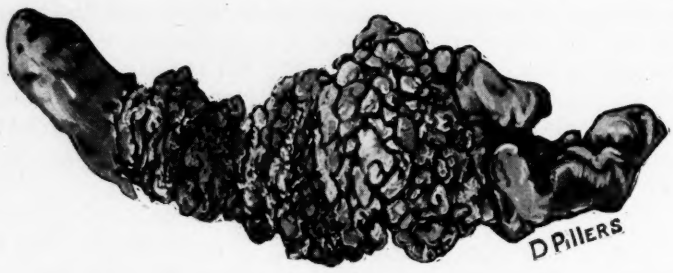

FIG. 161.—Intussusception of vermiform appendix. (¾ natural size.)

On examining the specimen removed, it was seen to be a completely inverted appendix. It was over 4 in. long, and 1½ in. wide at its base. The terminal inch was smooth, white, and bloodless. The mucous membrane over the rest of the organ was the seat of extensive soft papillomatous growth, most evident at the cæcal orifice. The base of the appendix was surrounded for a quarter of an inch by healthy cæcal wall.

A microscopical section of the growth was prepared, and Dr. Claridge, hon. pathologist to the hospital, reports it to be a malignant papilloma.

This case illustrates the fact that malignant growths of the appendix are prone to cause symptoms at an early stage, before lymphatic infection has become manifest. To this fact is attributed the relative freedom from recurrence after removal of a malignant appendix,[2] and this appears to me to be a plausible explanation.

REFERENCES.

[1] MOSCHOWITZ, "Intussusception of the Appendix", *Med. Record*, 1910, Dec. 17.
[2] *Keen's Surgery*, vi, 579.

OMPHALOMESENTERIC CYST CAUSING INTUSSUSCEPTION.

BY F. J. COUTTS, LONDON.

IN the BRITISH JOURNAL OF SURGERY, Vol. III, p. 145, there is a short note of an omphalomesenteric cyst causing acute intestinal obstruction; and in Vol. VIII, page 136, a case is reported of inflammation of Meckel's diverticulum simulating acute appendicitis. In the first case small cysts were also present in the abdominal wall, and in the second a cyst was found just behind the umbilicus but connected with the diverticulum.

The two cases recorded below were admitted to hospital within six weeks of each other.

The first, a boy, age 4, was sent in as a case of acute appendicitis. The symptoms did not suggest this common ailment, but rather intussusception, and after an enema had been given this opinion was strengthened by blood-stained mucus coming away in the wash-out. There was some resistance and tenderness in the right iliac region. Under

anæsthesia, a tumour was felt on the right side of the abdomen. The abdomen was opened to the right of the middle line, and the tumour was found to be an intussusception of the ileum into the cæcum and ascending colon. The reduction was easy, and towards the end of the reduction a projection was seen to bud out of the ileum, and on further manipulation a full-blown Meckel's diverticulum about three inches long was extruded. There was no mesentery.

The base of the diverticulum was clamped, ligatured, and cut off. The stump was inverted, and the operation terminated by closing the abdominal wound. The child made an uneventful recovery. Such cases have been recorded.

The second case, a boy, age 10 months, was taken with severe pain accompanied by vomiting on June 3, 1920, in the evening. Next day the pain was intermittent and there was less vomiting, but in the afternoon pain again became more frequent and vomiting restarted. The child was admitted to hospital about 10 p.m., June 4, with the diagnosis of intussusception.

Under the anæsthetic, the tumour was felt above and to the left of the umbilicus. The abdomen was opened to the right of the mid-line. The tumour was brought to the surface, and the first thing noticed was the tip of the appendix vermiformis projecting from the neck of the intussusception. The apex felt very hard, and suggested a fibroma in the small intestine. Reduction was easy except the last few inches, but with continuous pressure a cyst showed itself, and on further expulsion the peritoneal coat over the cyst cracked. The peritoneum and muscular fibres over the cyst were drawn aside, and with a dry gauze swab the cyst was enucleated from its bed—the flaccid mucous membrane of the bowel. There was no stalk into the bowel. The peritoneum was stitched over the raw area and the abdomen closed.

That night the child passed a good motion, and two more the following morning. Unfortunately the chest gave trouble and the child died from bronchopneumonia. The cyst was about two inches in diameter and contained clear fluid ; it was not opened.

The interesting question was, from what structure did the cyst arise ? From its position within a few inches of the ileocæcal valve it suggested the Meckel's diverticulum, and in this case apparently the umbilical and bowel connections had both become obliterated and left this cyst sessile on the bowel. I can find no reference to any such case.

REVIEWS AND NOTICES OF BOOKS.

Diseases of the Rectum. By Louis J. Hirschman, M.D., F.A.C.S. Large 8vo. Pp. 378, with 223 illustrations and 4 coloured plates. Third edition, revised and rewritten. 1920. London: Henry Kimpton. 30s. net.

The War produced no opportunities for advancement in general rectal surgery, and this edition, except for about forty additional illustrations, does not differ materially from the second.

Many of the plates, taken from photographs and illustrating operative technique, fail to give a clear idea of the methods employed; the hands of the surgeons and the instruments seem to fill most of the picture. Some of the best illustrations are to be found in the radiographs of diseases of the large intestine.

The author deals very fully with the method of examination and the use of instruments, and in the main we are in agreement with his views, though we have not found the inverted or Hane's position necessary in proctoscopy.

Constipation and obstipation are considered at length, and freely illustrated with radiographs. The author's method of curing chronic constipation by the use of a rubber dilating rectal-massage bag is worth a trial, in view of the successes which he claims.

Pruritus ani is carefully considered. and we find the usual plethora of prescriptions for treating the local dermatitis. The value of zinc ionization, and in some cases of x rays and radium, in clearing up local dermatitis is not referred to.

We are pleased to note that hypertrophy of the papillæ of Morgagni is mentioned and the pathological results discussed. The part which these small bodies play at the anorectal junction has been too long neglected by text-books.

Many text-book articles on rectal surgery fail, as does this volume, to draw attention to the great advantage of opening an ischiorectal abscess so that the mouth is 3- or 4-sided and not a mere slit, i.e., by a T-shaped or + incision followed by excision of the overhanging skin-flaps, to facilitate drainage and healing.

In the chapter on fistula, the author makes use of bismuth and radiography as an aid to diagnosis. We believe there is nothing to be gained by this method, and that results may be misleading. Induration felt under the finger is usually the best guide to the track of a fistula, and a probe causing pain is seldom required for purposes of diagnosis.

Throughout the book the author is a strong advocate of local anæsthesia, which he finds satisfactory even for ligature of internal hæmorrhoids. There is no doubt a tendency in this country not to use local anæsthesia with sufficient frequency, especially in anorectal complaints, but we confess to not being satisfied with its employment for ligature of hæmorrhoids.

The clamp and cautery method of treatment is condemned; we, however, have found this operation ideal as regards freedom from pain after operation and rapidity of recovery; but it is necessary to employ careful technique, and all cases are not suitable.

The frontispiece, an excellent coloured plate, illustrating a carcinoma of the rectum above and a plexus of hæmorrhoids below, stimulated us to turn with interest to the chapter on carcinoma. With some surprise we find only sixty-five lines devoted to cancer of the rectum, which appear in the chapter on the limitations of local anæsthesia. No less than forty pages are allotted to an article on dysentery by Dr. John L. Jelks. Some thirty pages at the end of the volume, devoted to clinical examination of the fæces, might well have been allotted to the most serious and most distressing of all diseases of the rectum.

Selected Lectures and Essays. By Sir John Bland-Sutton, F.R.C.S.Eng. 8vo. Pp. xi + 320, illustrated. London: William Heinemann (Medical Books) Ltd. 15s. net.

These selected lectures and essays shed much light upon the complex character of Sir John Bland-Sutton, and give many indications of the means by which he has attained the distinguished position he now holds in the world of science. The book as a whole is so full of personal vestigia that it is easy to reconstruct his life-history. In the dawn of his intelligence there was a primæval love of morphology, coupled with the insatiable curiosity of 'the elephant's child' spoken of by Rudyard Kipling in his *Just So Stories*. These primæval affections led him to study comparative anatomy—not in books as a German would have done, but—being a Londoner—at the Zoological Gardens and the Royal Veterinary College in Camden Town. Doubtless, too, the

res angusta domi made him a teacher of anatomy in the medical schools, and he was thus able to generalize on human anatomy to the enlargement of its boundaries and the advantage of his pupils. Hence came his essays on *Ligaments*, written in 1887, and now published as a fourth edition nearly a quarter of a century afterwards. These essays are twelve in number, and shed much light on various recondite anatomical problems. For the most part credit is given where credit is due, for a short bibliography is appended to each essay. By some mischance there is no reference to the work of William Kitchen Parker, who in many respects was the very spit or marrow of Sir John Bland-Sutton himself, a modest, plodding, Bible-loving practitioner of medicine, whose work on the shoulder-girdle deserves the most ample acknowledgement. At this period Sir John had not yet come to his own; the material is good, but he had not attained the facility in writing which he afterwards reached. His quaintness of expression, however, existed, as is shown in the statements that " the story of the guinea-pig's symphyseal ligament emphasizes the disadvantages which offspring with big heads entail on their mother," and " the flippers of whales, like the wings of penguins, resemble hands in mittens." The essays may be taken to represent the eozoic age in his mental development; the mesozoic period shows the author no longer following pure science, but turning his knowledge to account as a skilled hospital surgeon. In this aspect he discourses of pins in the vermiform appendix; of the expectation of life after operation for stone in the kidney; of jejunal ulcers; of the surgery of the heart and of missiles as emboli. The rapid march of surgery is well shown by reading the essay on wounds of the heart. Sir John —writing in 1910—estimates the mortality after operation in these cases to be 65 per cent, and makes no mention of the bundle of His. Tuffier, in 1920, gives the mortality as 50 to 55 per cent, and is able to quote innumerable cases. There is evidence in this mesozoic period that Sir John was directing special attention to gynæcology, for there are essays on tubal and abdominal pregnancy, and in this connection it would be of interest to know the difference between a harlot and a courtesan, for he states that in his experience tubal pregnancy is not common " in a harlot or a courtesan." The gynæcological lectures are full of interest, for they show the practical value of a knowledge of embryology and comparative anatomy.

Several of the remaining essays are of the nature of journalism, and are letters contributed to the *Morning Post*, telling of the bull-ring and of his experiences with a convoy in the North Atlantic during the War. Excellent reading, and showing that curiosity is still as predominant a feature in the author as it has always been. Lastly, in the series of chapters on " Medicine of the Bible," we learn that he has a sound working knowledge of the Old Testament and that he has travelled in the East, for he illustrates many of his remarks by first-hand knowledge of customs still prevailing there. Incidentally, too, we learn that he belongs to the Church of England, but as he accepts without demur the numbers which are so fallacious in the original, there is no evidence that he has studied the Scriptures in the original tongue.

The essays are all worth reading, not only for their intrinsic value, but on account of the interesting manner in which the information is conveyed, whilst the high reputation of the author is enhanced by their publication in this collected form. They are dedicated appropriately to the old students of the Middlesex Hospital Medical School. A word of praise must be given to the numerous illustrations, many of which have been drawn by Mr. C. Berjeau, the blocks being cut by Butterworth. They show the advantage possessed by woodcuts over process blocks for the illustration of pathological processes.

Surgical Shock and the Shockless Operation through Anoci-Association. By GEORGE W. CRILE, M.D., Professor of Surgery, and WILLIAM E. LOWER, M.D., Associate Professor of Genito-urinary Surgery, Western Reserve University. 8vo. Pp. 272, illustrated. 1920. London: W. B. Saunders. 21s. net.

THIS is the second edition of *Anoci-Association*, and is thoroughly revised and rewritten. Much additional matter, obtained from civilian and military experience corroborative of the soundness of the fundamental principles of anoci-association, is incorporated.

There is a short introduction on the evolution of the theory of shock and the shockless operation, followed by a chapter on the author's well-known kinetic theory of shock. The cause and pathology of surgical shock are then fully discussed, and beautifully illustrated by photo-micrographs showing the effects upon the cells of the brain, liver, and adrenals of exhaustive stimulation and the restorative effects of sleep. The subject is treated in a concise and lucid manner, and it is clearly demonstrated that the complete exclusion of both traumatic and emotional stimuli will wholly prevent the shock of surgical operations.

After briefly surveying the clinical phenomena, the authors proceed to describe treatment. This is essentially a practical application based on the principles laid down in the previous parts of the book. Every surgeon will agree that it is easier to prevent than to cure shock, and the method of prevention is described in thirteen chapters, each one detailing the necessary measures to be applied to a particular region of the body, and terminating with a few useful and pithy 'Dont's'.

Anyone who has practised the anoci-association technique will be in full agreement with the authors when they contend that it is not always necessary, but to be able to perform it efficiently

when it is required it is essential that it should be always applied. There are so many points where a break may occur, not only in the surgeon's work, but in that of any one of his team, that it is necessary to be always utilizing it, so that it may become as automatic as is the case with a thoroughly aseptic technique.

Great stress is laid upon the beneficial effects of morphia at all times, in the absence of cyanosis: this symptom indicating, in the authors' opinion, a state of acidosis, in which it is dangerous to give morphia, as it then impedes the efforts of the body cells to rectify the medium.

Chapter XXI sets out the technique, physiological effects, and dangers of blood transfusion, and gives a short description of the blood groups. The authors are quite satisfied of the great usefulness of this method of treatment in shock.

Chapter XXII deals with anæsthesia, and shows how the general anæsthetics, with the exception of nitrous-oxide oxygen, fail to protect the central nervous system against the exhausting effects of harmful stimulation.

The authors contend that the practical value of anoci-association is attested by the fact that in their clinic both the mortality and post-operative morbidity have been reduced by the application of the principles, and by the fact that, when tested on an enormous scale in the vast surgical theatres of the War, the principles of anoci-association have been clearly sustained.

This is undoubtedly a book which all surgeons who desire to do the utmost for their patients should acquire, read, mark, learn, and inwardly digest. Like most of Crile's work, it is based on extensive and elaborate experimentation; and though everyone may not agree with his theories, there can be no doubt about the soundness of the application of an efficient anociation in practical surgery. The book is well got up, the type is good and clear, the plates are beautiful, and there is a full index attached.

Plastic Surgery of the Face. Based on Selected Cases of War Injuries of the Face, including Burns. By MAJOR H. D. GILLIES, C.B.E., F.R.C.S., with chapters on Prosthetic Problems of Plastic Surgery by CAPTAIN KELSEY FRY, and on Anæsthetics by CAPTAIN R. WADE. Large 4to. Pp. xii + 408. With original illustrations. 1920. London: Oxford Medical Publications. £3 3s. net.

THIS is a handsomely-illustrated volume recording the results of plastic surgery used to restore the disfigured faces of wounded soldiers. In the first years of the War this work was largely neglected; the methods in use were meagre and antiquated, and had not kept pace with the advances in general surgery. The result was that many wounded men were left with scars and horrible deformities which were grievous and crippling to themselves and distressing to all who saw them. The work of Major Gillies and his coadjutors has to a great extent remedied this lack, and the principles and technique of the art of plastic surgery have been put on a sound basis. The work has been bold in conception, and carried out with the skill and indomitable patience which this branch of surgery demands.

There are two main points which strike one on reading this book. Firstly, plastic surgery, if it is to be successful, must restore function as well as looks. In the past it has been largely cosmetic. In this book it is shown that the restoration of a nose must be associated with an efficient air-way, and a graft, to remain of use, must be exercised. The second point is one of technique, and is concerned with the formation of flaps. The subject of the fashioning of flaps figures very largely, and it seems that a great advance has been made in the method of forming tubular flaps, by which means skin can be removed from comparatively long distances to cover defects.

Incidentally, much light has been thrown on the whole question of the life of grafts, both of skin, bone, and cartilage, their resistance, capability of life, and independent growth.

It seems likely that the methods here detailed may have an important bearing on the future surgery of scars, disfiguring tumours, and deformities.

Las Amputaciones Cineplasticas (Kineplastic Amputations). By DR. GUILLERMO BOSCH ARANA. Demy 8vo. Pp. 352, with 194 illustrations. 1920. Buenos Aires: *La Semana Medica*, Imp. de Obras de Emilio Spinelli.

NOTWITHSTANDING the fact that kineplastic amputations were proposed by Vanghetti in 1898, and have been performed in increasing numbers since Ceci's first reported operation in 1905, we fear that it cannot yet be said that the proceeding has established for itself a permanent position in practical surgery. There have been hundreds of publications on this subject, and many operations have been performed, especially in Italy and Germany, and we may safely say that we are now in possession of enough experience to establish a satisfactory operative technique. Good plastic motors can be produced, but there has been and still is great difficulty in adapting to them strong and useful prostheses.

Professor Bosch Arana, of Buenos Aires, has made kineplastic stumps in twenty cases, and has given us full details of them in the work now under notice, together with a valuable review

of the whole subject. In the first place it is noticeable that, unlike most series of kineplastic amputations, this one consists of civilian cases, and that the majority affect the lower extremity, with which European surgeons have not as yet been extensively concerned, and that seven cases were primary kineplastic amputations.

Only five of the twenty cases have been satisfactorily fitted with apparatus, and it is most significant that only one of these is an amputation of the upper extremity. This fact bears out European experience of the great difficulty of devising and applying a satisfactory artificial arm for a kinematized stump.

One case of amputation in the upper third of the femur is justly claimed by Dr. Bosch Arana as unique in the world's literature. Amputation was performed on account of hydatid disease of the bone. The superfluity of skin made the covering of the motors easy. Despite the high site of the bone section, the whole of the thigh muscles were preserved and used, forming one extensor club (clava) motor containing the patella, and one flexor loop (ansa) motor containing the hamstring muscles. The result is reported as ' admirable '.

Dr. Bosch Arana, like many other surgeons, does not favour the tunnel motor, so much in favour in Germany. He prefers the loop, and occasionally, as in the last case, the loop accompanied by the club motor. He thinks that at present two is the maximum number of motors that can be used, but does not despair with improved apparatus of making use of three.

This book contains a good history of the subject, and descriptions and diagrams of various artificial hands, and also of the ergograph devised by the author. It is, however, deficient in representations of artificial legs, particularly those found useful for the four successful lower-limb cases. It is just on this point that more light and full details are needed by surgeons and limb makers.

We welcome this book as a candid scientific statement of the case; and although it is written in the Spanish tongue, the numerous illustrations and the table of cases make it worth the study of those who have no knowledge of that language.

Diathermy in Medical and Surgical Practice. By CLAUDE SABERTON, M.D. Pp. xii + 138, illustrated. 1920. London: Cassell & Co., Ltd. 7s. 6d. net.

THIS book forms one of the series of ' Modern Methods of Treatment,' and is intended as a guide to students and practitioners who wish to master the technique of diathermy, and to understand its place in the treatment of diseases.

The book is divided into three parts. In the first are described the apparatus used, the physical and physiological effects of diathermic currents, and the methods of application. These points are discussed very fully and in considerable detail, and illustrations are employed which help materially in the understanding of an apparatus which at first acquaintance appears to have a very complex design. Under physiological effects the author points out that, while these appear to be mainly brought about by the heating of the tissues, this is not necessarily the only beneficial action of high-frequency currents.

In the second part of the book the effects of diathermy are discussed from the medical aspect in the treatment of some diseases of the circulatory and nervous systems, of fibrositis, scars, adhesions, and diseases of joints, of thoracic and other affections. In all these conditions the endeavour is to raise the temperature of the tissues within physiological limits, whereas in surgical affections, which are discoursed upon in the third part, this limit is intentionally exceeded and the tissues destroyed. The author has had a large experience with diathermy and speaks very confidently of its excellent qualities.

The surgical affections which are particularly mentioned are: superficial lesions, as nævi, moles, acne, etc.; papillomata of skin and mucous membranes; malignant growths, especially those of the mouth and nasopharynx; various inoperable growths; papillomata of the bladder; vascular tumours; and rodent ulcer.

The advantages and disadvantages are tabulated, and the technique is fully described. There is quite an extensive bibliography appended and a sufficient index. The book is essentially a practical one, and amply fulfils the purpose for which it is intended.

Surgical Treatment: a Practical Treatise on the Therapy of Surgical Diseases; for the Practitioners and Students of Surgery. By JAMES PETER WARBASSE, M.D., F.A.C.S. Three volumes. Vol. II, pp. 829, figures 759, and Vol. III, pp. 861, figures 865. 1919. London and Philadelphia: W. B. Saunders & Co. £7 7s. 0d. net.

THIS system of surgical treatment, the first volume of which was reviewed in an earlier issue, has fully come up to its promise of completeness and exactitude.

In the first of the two volumes under present review the following subjects are dealt with systematically: injuries and diseases of the head, the eye, the nose, the larynx and trachea, the mouth, ear, spine, neck, thorax, and abdomen. The scope, therefore, of this volume covers

the principal domain of operative surgery. The chapters on head surgery give a good account of different methods of hæmostasis and of craniotomy in exposure of the brain; but the scope of the work naturally precludes any discussion as to the details of the diagnosis of cerebral conditions. The surgery of the eye occupies about sixty pages, and the question naturally arises whether it is possible to cover the ground adequately in this short account; possibly the same criticisms would apply to the sections on the other less defined surgical specialities, namely the ear, nose, and throat.

It is rather remarkable that in the sections dealing with cleft palate the method of Brophy should not have one single illustration. It is described in one paragraph, after which occurs the following curt statement, "This operation was once very popular. Now, those most in favour with surgeons doing much of this work are the sliding-flap operations."

As in so many works of this kind, the space given to rare conditions is quite out of proportion to their importance. For example, there are more space and illustrations devoted to deformities of the lower jaw than to the important subject of carcinoma of the tongue.

The surgery of the chest is described very much as it might have been ten years ago, when it was considered that complicated questions of differential pressure dominated the problem of all operations involving the opening of the thorax.

In the treatment of cancer of the breast, the extent to which the skin is removed is greatly in excess of what is usual in this country, but no very clear rules are laid down indicating how extensive this removal should be. A considerable number of plastic devices are illustrated for making good the great loss of skin.

The chapters dealing with abdominal surgery follow very much the same lines as those of an ordinary book on operative surgery—that is to say, the various classical operations are clearly figured and well described.

The author has little to say in favour of the operative treatment of chronic intestinal stasis; it seems a pity that he has allowed himself to illustrate an impossible type of stricture of the colon just for the sake of allowing the artist to picture its perfect cure.

The last volume deals with hernia, the rectum and anus, the appendix, the liver and gall-bladder, kidneys, ureters, bladder, prostate, the male and female generative organs, the extremities, amputations, plastic and cosmetic surgery, first-aid to the injured, and surgical bandaging. The descriptions of the surgery of the liver and gall-bladder, together with the other abdominal subjects of this volume, are good, there being a very detailed account of the various methods of reconstruction of an injured bile-duct. The section on genito-urinary surgery contains a great deal of valuable information, with useful illustrations, but we venture to think that it is somewhat marred by the inclusion of obsolete operations and instruments, such as the prostatic punch (*Fig.* 1663), and the urethrotome of Otis (*Fig.* 1706); a disproportionate space is given to operations for malformations such as epispadias and hypospadias, whilst the modern operations for the excision of strictures of the urethra are barely mentioned. The sections on the extremities include a somewhat brief account of the treatment of deformities. The chapters on amputations are good because they describe the various methods of fashioning cineplastic stumps suitable for different sites.

The author of this large and important work is to be congratulated greatly on the general excellence of his achievement. While it is easy to criticize details in such a work, it would be extremely difficult to produce a better one. The printing and illustrations leave nothing to be desired, and we feel sure that it will not be very long before Dr. Warbasse has an opportunity of revising his work in the pages of another edition.

Fractured Femurs: their Treatment by Calliper Extension. By Brevet Lieut.-Colonel G. Pearson and J. Drummond, M.D. With Foreword by Colonel Sir H. M. W. Gray. Large 8vo. Illustrated. Pp. xii + 92. 1920. London: Oxford Medical Publications. 10s. 6d. net.

This little book represents the specialized work of the authors during the last few years of the war, and particularly during the time when they were in charge of a special military surgical hospital at Edmonton which was devoted chiefly to the care of gunshot fractures of the femur. The work is an excellent illustration of how much can be done by a good team of men whose attention is concentrated upon a single problem, when led by a man of judgement and enthusiasm. Pearson seems to have begun on the lines of Jones and Sinclair, and then he improved various details of apparatus and standardized a system of his own.

The chief features of his method are three in number, viz., the use of a special form of ice-tongs caliper for applying extension to the femur, a bed designed for the treatment of fractures, and provision for mobilization of the knee and ankle from the outset in all cases.

The calipers which grasp the femur are so designed that their points cannot penetrate the bone more than a given distance; in fact the authors claim that they do not penetrate at all. We must take leave to doubt this statement, as also the advantage of a caliper over a transfixion pin. In both, the danger of sepsis in an infected limb is the great drawback, and the caliper, in its seton action, its proximity to the knee-joint, and its penetration of the fascial planes of the thigh, is in

exactly the same position as the pin, with the additional drawback of being mobile. However, the fact remains that in a very large series of cases efficient extension was obtained by the calipers without evil result, though we attribute the latter fact to the care taken in general technique rather than to the virtue of the calipers as such.

The success which followed the systematic mobilization of the knee throughout the whole course of treatment is perhaps the most gratifying feature of the system.

The Course of Operative Surgery. By PROFESSOR VICTOR SCHMIEDEN. Translated by ARTHUR TURNBULL, M.B., Ch.B. With Foreword by PROFESSOR DR. A. BIER. Large 8vo. Second English edition. Pp. xx + 350, with 436 figures. 1920. London: Baillière, Tindall & Cox. 26s. net.

THIS is an ordinary student's text-book of operative surgery, a guide to operations upon the dead subject. It does not include any account of even simple operations on special organs, such as the nose, eye, or uterus. We fail to find in its pages any cogent reason for its translation into English, even though it is introduced by a foreword by Professor Bier.

Die deutsche Chirurgie im Weltkrieg, 1914–1918. By A. BORCHARD and V. SCHMIEDEN. In two volumes. Pp. 938, with 487 illustrations. Second edition. 1920. Leipsic: Johann Barth. 102 Mks.

THIS German War Surgery, contributed to by thirty professors, and prefaced by two notices, the first written in 1917, "the third year of the great War", and the second in the autumn of 1919, when "the War has come to a sudden and unexpected end", is a work which claims our interest for more reasons than one. We look through its pages chiefly to find whether the problems which confronted us so lately have been experienced by those on the other side; how those problems have been solved; and whether the solution has been better than, or not so good as, our own.

The work is, however, a disappointing one. It is far too short to deal with the subject at all adequately, and such a large proportion of its pages is taken up with routine surgery that there is no adequate discussion of the essential difficulties of military surgery.

The best section of the first volume is that dealing with the anatomy of various gunshot wounds. In regard to practical matters of treatment, the following points may be noted in comparison with our own experiences. As regards the problem of wound infection and disinfection, the main reliance is placed upon early excision, drainage, and various methods of hyperæmia. Wright's methods, and also that of Carrel-Dakin, are mentioned with approbation; also a special turpentine derivative named 'vuzin' which, used in proportions of about one to ten thousand, has all the valuable properties claimed for every new antiseptic. There is no mention of the aniline-dye preparations. The use of plaster-of-Paris as a routine method of immobilization of wounded limbs is extolled. The section on the treatment of deformities is much too short to be of any value.

The second volume deals with special subjects in detail. Except for a few diagrams it is very sparsely illustrated. The sections which deal with the head, chest, and abdomen give a good general idea of the subjects treated, whilst those on the more specialized subjects, such as plastic surgery of the face and of the jaw, and also that dealing with individual fractures, are too short to be of much practical value.

Surgical Therapeutics and Operative Technique. By E. DOYEN. English edition prepared by the Author, in collaboration with H. SPENCER BROWN. Vol. III, Regional Surgery. Roy. 8vo. Pp. x + 811, with 957 illustrations. 1920. London: Baillière, Tindall & Cox. 45s. net.

THIS third volume completes the English edition of the work. The long delay between the appearance of the first two volumes and the third was caused by the sudden death of the author, and the translator's absence on war duty. The present volume is a continuation from Vol. II on regional surgery, and is divided into two sections. The first deals with the surgery of the abdomen proper, and the author has incorporated a résumé of his researches into the physiology of the stomach and gastric digestion. The second part is devoted mainly to surgery of the female generative organs, and goes very fully into the operation of vaginal hysterectomy in particular. Operations on the genito-urinary system of the male are also dealt with. There are many excellent drawings and photographs taken from sections of the frozen body, which reveal most interesting anatomical relations.

This volume, like the previous two, is replete with instances of the originality and versatility of the author, and does not describe a variety of operations for any one condition, but those which the author himself practised, and in many cases originated. There is, however, in the volume

much to condemn; this was not the case in the other two. Whilst reading the sections on the gall-bladder and stomach it is difficult to realize that these are appearing in a book published in 1920; they read like the surgery of twenty years ago.

There are, undoubtedly, some very good sections, but on the whole the volume is a poor one. Treatment is set out, as that which the author recommends, which surgeons of to-day would strongly condemn. As instances may be taken Doyen's practice of removing stones impacted in the cystic duct and suturing the gall-bladder subsequently; also his custom was to employ marsupialization of the gall-bladder when the walls were so diseased as to render closure impossible or dangerous. The approach to the gall-bladder and the spleen recommended by him can only be considered as unwarrantably savage, involving, as it does, section of the 8th, 9th, and 10th costal cartilages, in the one case on the right side and in the other on the left.

Again, the section dealing with the stomach and duodenum is hopelessly out of date. It teaches that gastric ulcer is more common than duodenal ulcer, and that the diagnosis of the latter is more difficult than that of the former; whereas in each case exactly the reverse is the view held by modern surgeons. Perhaps a qualification is necessary here, as Doyen was not alone amongst Continental surgeons in the views he held on these points. But we think that in 1920 all surgeons will agree that *x* rays are of great value in differentiating cancerous from non-cancerous affections of the stomach. *X*-ray specialists regard the filling defects seen in cancer of the stomach as conclusive evidence of the presence of this disease. Doyen, however, held a different opinion. Again, in the part of the volume dealing with stone in the kidney, Doyen barely mentions removal by incising the pelvis of the kidney; he practically always incised the kidney itself. This is another instance of bygone surgery.

It would be tedious to multiply instances of this kind, all pointing to the same conclusion, that the third volume of the work, though published in 1920, really contains less surgery of this date than of that practised fifteen or twenty years ago.

As an exposition of the methods of Doyen this book is very good and well got up; but it cannot be considered as a modern work on surgery in any sense.